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NEW SERIES—VOLUME 38, PART 4

1948

THE LOWER PALAEOLITHIC CULTURES OF SOUTHERN AND EASTERN ASIA

HALLAM L. MOVIUS, JR.

Curator of Palaeolithic Archaeology

Peabody Museum, Harvard University

THE AMERICAN PHILOSOPHICAL SOCIETY

INDEPENDENCE SQUARE

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MAP 1. Southern and Eastern Asia showing localities to which reference is made in the text.

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"Prehistory is essentially the study of mankind:
the underlying humanity must never be forgotten
for a single moment in dealing with Man's cultures."
A. J. H. GOODWIN

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I. INTRODUCTION

This paper is in the main a restatement of views expressed by the writer in a monograph entitled "Early Man and Pleistocene Stratigraphy in Southern and Eastern Asia," which was published during the war as Vol. XIX, No. 3 of the Papers of the Peabody Museum of Harvard University in 1944, and which is now out of print. In the present version the archaeological material from the regions under consideration is summarized primarily for anthropologists and prehistoric archaeologists, and all detailed geological and palaeontological arguments are omitted. A very much simplified section dealing entirely with chronology is included, however, in order to provide a basic framework into which to fit the prehistoric archaeological material.

The work of the Joint American Southeast Asiatic Expedition for Early Man, which conducted a five-months' field program in the Irrawaddy Valley of Upper Burma during the 1937–1938 season,[1] has led to the recognition of a new Lower Palaeolithic cultural development in Southern and Eastern Asia, which began during Middle Pleistocene times.[2] Burma was originally selected because of its geographical position midway between the three fairly well-known regions of Northwestern India, Northern China, and Java. As the result of a continuation of the expedition's work to include a trip to Java in the spring of 1938, the significance of the results of the field work as a whole was enormously broadened. For, near Patjitan in the south of Java, Dr. G. H. R. von Koenigswald had discovered an extremely important new Lower Palaeolithic site during the autumn of 1935.[3] Dr. von Koenigswald's material, some of which is included here with his generous consent, was studied both in the field and in Bandoeng. Its age is presumably Middle Pleistocene; however, on the basis of present evidence, one cannot assert that it represents "the culture of *Pithecanthropus erectus*" without being guilty of a premature statement, the validity of which *cannot* as yet be demonstrated. But the probability is that, if the tools in question were not made by *Pithecanthropus erectus*, they were made at least by his direct descendants. At the site of Choukoutien: Locality 1 in Northern China, on the other hand, the unquestioned association of the osseous remains of *Sinanthropus pekinensis* with stone implements of the Choukoutienian culture certainly proves that the so-called Java Ape-Man's Chinese cousin was capable of the efficient production of a considerable range of types of implements. Moreover, on typological grounds, the Choukoutienian material is very similar to that found at Patjitan in Southern Java, as well as in the Irrawaddy Valley of Upper Burma and in the Punjab Province of Northwestern India. As previously stated, these several developments appear to be related to each other, and, as a group, to form an interesting new culture-complex. In this paper an analysis will be presented on the various components that make up this complex, and it will be shown not only how they are related to each other, but also how they fit together in time and space. Finally, it will be indicated how this complex as a whole differs from contemporary developments in other regions of the Old World.

[1] de Terra, Teilhard, and Movius, 1938; de Terra, 1938*a*; 1938*b*; 1939; 1940*a*; 1940*b*; de Terra and Movius, 1943.

(The complete title of a publication to which a footnote refers is contained in the list of References, pp. 412–420.)

[2] Compare Le Gros Clark, 1946*a*; Braidwood, 1947: 36–42.

[3] von Koenigswald, 1936*c*; 1936*d*; de Terra, 1943: 457–459; Movius, 1944: 91–94.

II. PLEISTOCENE CHRONOLOGY

As has been recognized since the middle of the last century, research on Early Man and Old Stone Age cultures is intimately and directly related to those fields of Natural Science which deal with Late Cenozoic stratigraphy. In fact, the two cannot be separated. Since it is imperative to approach both palaeo-anthropology and prehistoric archaeology from an historical point of view, some sort of chronology, based on a synthesis of the most reliable evidence available, is vitally necessary. For otherwise the data completely lack all semblance of objectivity; they simply consist of a series of isolated abstractions to be classified and compared at will by the pseudo-archaeologist. Throughout it must be constantly borne in mind that Palaeolithic cultures and complexes of cultures are represented today only by the imperishable products of prehistoric Man's material culture—assemblages or aggregations of stone tools for the most part—manufactured during a given stage. But they must always be regarded as *social* rather than *natural* phenomena; therefore, they can neither be subjected to rigid systematization nor bounded by fixed laws. For the tools are the material manifestations of a thinking brain, and as such can never be subject to the laws of natural evolution. In other words, as Professor Garrod has recently stated,[1] "Stone implements . . . are *artefacts*, imagined and made by Man, and variable at his free will; to ignore this element of incalculability is to force prehistory into a strait-jacket."

A substantially similar opinion has also been very clearly expressed by A. J. H. Goodwin in a recent paper,[2] as follows:

> It is first and always essential to appreciate that prehistory is not, and never can be, a Science. Certain of the methods employed may be basically related to those used for the Natural Science, while the whole is directed towards the revelation of truth; yet the material upon which our evidence is based is of such a nature that it cannot be expected to yield absolute truth. Our research is a process of approximation, not of exact assessment. Man is an animal with powers of independent thought and invention, and with a free will. Through the constant use of clothing, tools,

[1] Garrod, 1946: 9.

[2] Goodwin, 1946*a*: 91.

housing and common sense, he is the most adaptable creature in the face of static and changing climates.

Inevitably, therefore, the implements themselves, even those produced *at the same time* in two adjacent regions, are bound to display a considerable degree of variability, and cannot be used *per se*, except in a very broad sense, as "index fossils" for dating the deposits in question. At present the archaeological literature is full of instances of the pitfalls that await the typologist, who has attempted to establish the age of a given deposit on the basis of the study of the stone artifacts found therein. Obviously, to fix the age of any archaeological horizon in the Pleistocene calls for more reliable evidence, which can only be forthcoming from the Natural Sciences. For, as Garrod has so aptly remarked,[3] "In the study of Early Man, the Natural Sciences in their rightful place remain indispensable, and form part of the essential structure of the subject." In this sense "the formation . . . of a prehistorian calls for a scientific discipline to which the student of the later stages of Man's story is not normally submitted."

With this concept in mind, the Late Cenozoic sequences in the several regions discussed in this paper will be summarized, and an attempt will be made to show how they may be correlated with each other, in the light of the sum total of the evidence secured to date.

As stated on page 339, Émil Haug's definition of the Plio/Pleistocene boundary has been adhered to throughout,[4] in order to provide a constant base-line for purposes of establishing broad-scale correlations. In spite of various arguments to the contrary,[5] this seems to fit more nearly what is known at present concerning the implications of all the available facts than any other scheme or interpretation yet devised,[6] when *all* the data are evaluated, analyzed, and considered as one coherent whole.

JAVA

As the result of Dr. G. H. R. von Koenigswald's brilliant discoveries of new early hominid material from the Pleistocene deposits exposed at Sangiran, a small village some 6½ miles north of Soerakarta in Central Java (see map 1),[7] during the five years prior to the Japanese capture of this tropical island, great interest has been focused on the geologic age of this material in terms of the well-established sequence of the mainland. Now the Late Cenozoic deposits of Java, which although an island should be considered as a severed portion of the ancient mainland of Asia, have been investigated by many scientists for over half a century—in fact, ever since 1891, when Professor Eugène Dubois unearthed the now-famous remains of *Pithecanthropus erectus*, the "Java Ape-Man," at Trinil, a hamlet west of Ngawi on the right bank of the Solo River in Central Java (see map 1). Originally Professor Dubois described the Trinil Beds as Lower Pleistocene or Upper Pliocene, but later he became convinced that this horizon definitely belonged to the Upper Pliocene.[8] Later investigations by the Selenka Expedition, which excavated at Trinil in 1907–1908, however, confirmed Dr. Volz's conclusion regarding the Lower Pleistocene age of *Pithecanthropus*.[9] More up-to-date and exhaustive studies based on the Late Cenozoic marine molluscs of Java by Dr. van Es likewise indicate a Pleistocene dating for the Trinil Beds.[10] But it was only in 1933 that detailed work by the Geological Survey of the Netherlands East Indies in Central Java finally led to the recognition of three clearly defined faunal and stratigraphic zones in the Late Cenozoic history of that island.[11] As late as Upper Pliocene times Java was under the sea, with the exception of the Kendeng Hills and the Zuider Mountains, which then represented groups of small islands. Toward the close of the Pliocene a gradual movement of emergence began in a west → east direction. This movement was accelerated with the onset of the first stage of continental glaciation during the beginning of the Pleistocene, an event of the first order of magnitude which caused a world-wide lowering of the sea-level.[12] As more and more of the waters of the oceans became incorporated into ice, the shallow sea separating Java, Sumatra, and Borneo from the mainland of Southeastern Asia receded, and a portion at least of the Sunda Shelf[13] became dry land, as shown on map 2. For

[3] Garrod, 1946: 7 and 10. See also comments by J. G. D. Clark (1944: 21) concerning collaboration between prehistorians and natural scientists.

[4] Haug, 1911: 1761 and 1767.

[5] Pilgrim, 1944; Zeuner, 1945: 174–175; 1946: 274. See also footnote 63 on p. 339 of this paper.

[6] Compare Matthew, 1929: 438–439; Hopwood, 1935*a*: 46–47; 1936*a*: 900; 1936*b*; 1940: 80; Colbert, 1935: 23; 1937: 179; 1938: 278; Lewis, 1937*a*: 194; de Terra, 1937*b*: 300; 1940*a*: 121; de Terra and Teilhard, 1936: 819; de Terra and Paterson, 1939: 255; Teilhard, 1937*a*: 212; Paterson, 1940: 12; 1941: 378; Movius, 1944: 8–9. As far as China is concerned, Dr. Teilhard de Chardin is somewhat reluctant to move the Villafranchian out of the Late Pliocene (see Teilhard, 1937*b*; 1938*a*; 1941; Teilhard and Pei, 1944: 10, fig. 1; also footnotes on pp. 345 and 388 of this paper).

[7] von Koenigswald, 1937*b*; 1938*a*; 1938*b*; 1938*c*; 1939*b*; 1940; von Koenigswald and Weidenreich, 1938; 1939; Weidenreich, 1940*a*.

[8] Dubois, 1894; 1896; 1908.

[9] Selenka and Blanckenhorn, 1911; Volz, 1907; see also Elbert, 1908; Stremme, 1911; and Osborn (1929), who, on the basis of Dietrich's (1924) studies of the Proboscidean and other vertebrate remains from the Trinil Beds, stated that in his opinion *Pithecanthropus* was of Middle Pleistocene age.

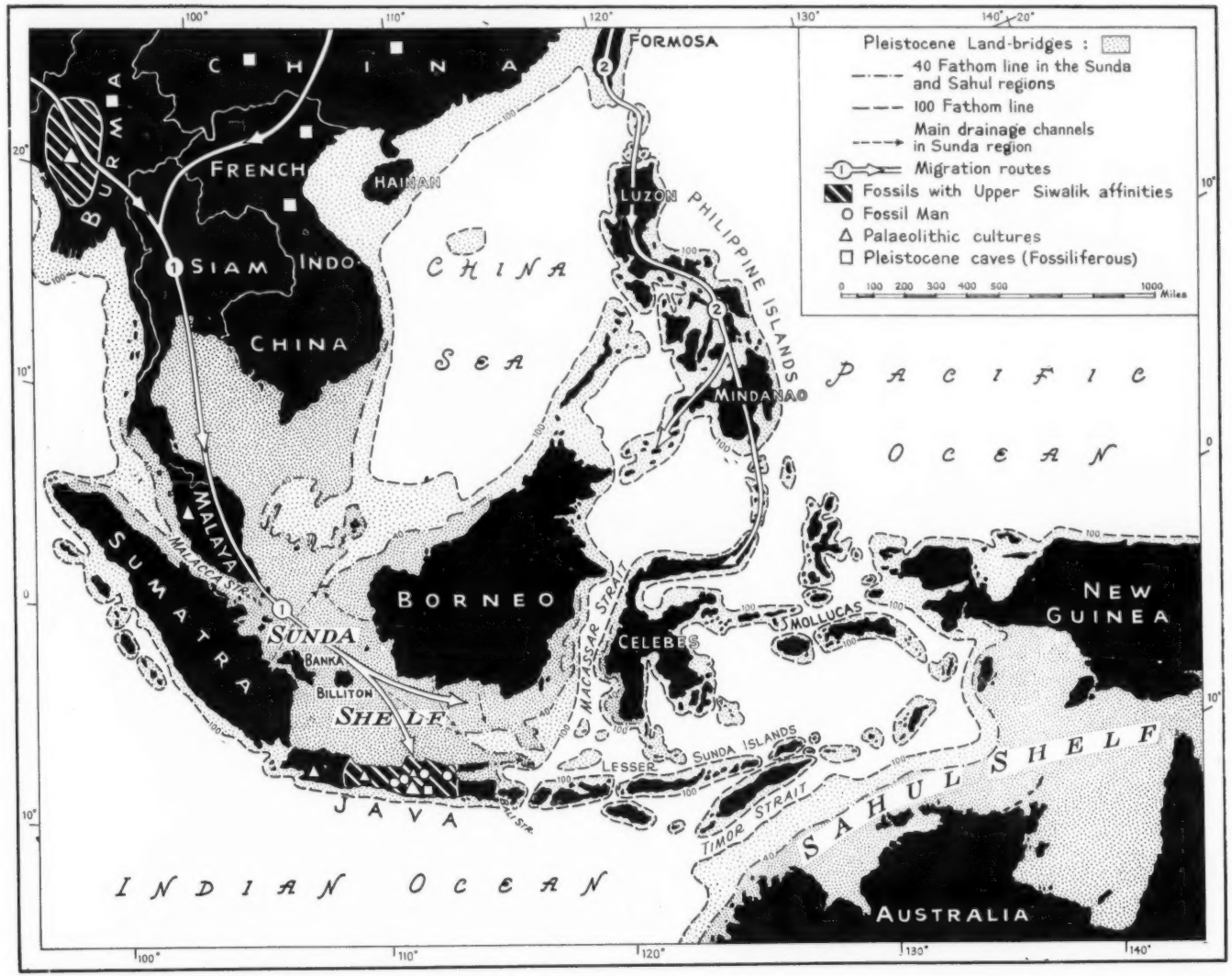
[10] van Es, 1929; 1931; 1933.

[11] von Koenigswald, 1933*a*; 1934; 1935*a*; Duyfjes, 1936.

[12] Daly, 1910; 1915; 1934: 165–185; Molengraaff and Weber, 1921; Penck, 1882; 1933.

[13] Brouwer, 1926; de Terra, 1943: 459–461; Dickerson, 1941; Dickerson, Merrill, McGregor, *et al.*, 1928; Kloss, 1929: map 1; Krempf and Chevey, 1934; Molengraaff, 1921; 1929; Molengraaff and Weber, 1921: fig. 1; Umbgrove, 1929; Zeuner, 1941; 1943: 153–157.

The *Sunda Shelf* has been defined as follows by Boden Kloss:



MAP. 2. Pleistocene land connections in the East Indies during the Glacial Stages of low sea-level, and suggested migration routes. The present isobath (or depth-line) of approximately 40 fathoms (240 feet; 73.15 meters) indicates the position of the ancient coast-line of that region of the stable portion of the Netherlands East Indies (including the Sahul Area) which was dry land during the phase of low sea-level that was concomitant with the last Glacial Stage of the Pleistocene. (Based on Molengraaff, Brouwer, Kloss, and Umbgrove.)

only in this manner can the earliest migration of land mammals, including Man, to the island of Java be explained.

The most direct method of dating the stratified beds containing early hominid remains in Java is provided by vertebrate palaeontology. But here one must proceed with caution. Throughout the Pleistocene there was more or less constant deposition under conditions of a fairly wet, tropical climate, hence it is as yet impossible to recognize "pluvial" and "interpluvial" periods[14] on the basis of soil studies.[15] This factor of a fairly equable climate, together with the relative isolation of Java in relation to the Asiatic mainland, led to the survival of several "archaic" elements (e.g., the Stegodon) as relic species, as late as Upper Pleistocene times.

LOWER PLEISTOCENE

That terrestrial conditions were fairly well established in Western Java by the beginning of the Lower Pleistocene is demonstrated by the evidence of several localities east of Bandoeng, where vertebrate mammalian remains have been found.[16] Although only a scanty list of forms has thus far been identified, the presence of small Cattle (*Bos*) and *Archidiskodon* (*Elephas*) *planifrons*, together with other typically Upper Siwalik mammals, proves that these beds are to be correlated with the Tatrot Zone in Northwestern India (see p. 338), which marks the beginning of the Pleistocene in that region.[17] Indeed the evidence obtained to date indicates that during this period, the time of the First Glaciation of the Himalayas (see p. 339), Java was joined to the mainland of Asia by a land-bridge.[18] This made possible the dispersal of typically Upper Siwalik mammals to the newly formed land-mass that was later to become the island of Java. Because of its marked Siwalik affinities, Dr. von Koenigswald[19] has named this the "Siva-Malayan" fauna.

Also to the Lower Pleistocene belong the *Poetjang* Beds, which yield a rich fauna widely distributed in Central and Eastern Java; the type locality, Djetis, lies approximately 24 miles west of Soerabaja.[20] As regards the Djetis fauna, its Lower Pleistocene character is unquestioned. The oldest human fossils from anywhere in Asia have been found in this zone—*Homo modjokertensis*,[21] *Pithecanthropus robustus*, and *Meganthropus palaeojavanicus*.[22] The two latter extremely important finds will be described in detail in a forthcoming volume by Dr. von Koenigswald and the late Dr. Weidenreich.

MIDDLE PLEISTOCENE

In the Kendeng Region of Central Java the *Kaboch* Beds, containing the famous Trinil fauna, conformably overlie the *Poetjang* Beds.[23] That the lower portion of this zone is probably to be correlated with the Second Glacial Stage in the Himalayas is indicated (*a*) by the arrival in Java at this time of a new fauna, called "Sino-Malayan" by Dr. von Koenigswald,[24] because it contains many typically Far Eastern elements also found in the Middle Pleistocene deposits of Southern China, and (*b*) by the fact that at Trinil (fig. 1), the site of Dubois' original discovery of *Pithecanthropus erectus*, the flora from the clay layers that immediately overlie the basal Middle Pleistocene "bone bed" demonstrates that a

"that great, little disturbed, flat area of shallow sea-bottom which extends southward from Indo-China, having everywhere depths of less than 100 fathoms, and over the greater part of its expanse of even less than 40 fathoms. It embraces the Malay Peninsula, Sumatra, Java, Bali, Borneo, Balabac, Palawan, the Calamianes and Cuyos Islands (the last four only politically Philippine), the smaller intervening islands and those adjacent to the shores of the others—in fact, all the land masses on the Sunda Shelf" (Kloss, 1929: 4). This region is a stable land-mass, and it rests upon an ancient and firm continental base of granitic rocks (Dickerson, Merrill, McGregor, *et al.*, 1928: 98–104).

Perhaps the most outstanding feature of the Sunda Shelf, which is the greatest submarine shelf (area = 1,850,000 sq. km.) known on earth, is its constant depth (average = 30 fathoms), as well as the perfectly even and undisturbed nature of its surface (see Molengraaff, 1921: 100). Since the present distribution of land animals (Dammerman, 1929; Rensch, 1937) and fresh-water fish (Krempf and Chevey, 1934: 851–852) in the Indonesian Archipelago can only be explained on the basis of a former direct land connection with Southeast Asia, there can be no doubt concerning the fact that this area was dry land during the Pleistocene glacial periods of low sea-level.

On the basis of a study of the valley of Molengraaff River, a great northward-flowing steam of the Ice Age in the Sunda region, the sea-level appears to have been between 40 fathoms (240 feet or 73.15 meters) and 50 fathoms (300 feet or 91.44 meters) lower during the Last Glacial Stage than it is today. Therefore, at the time of the Second Glaciation, it may be safely assumed that the drop was even greater—possibly as much as 70 fathoms (420 feet or 128.01 meters), but this difference would not materially alter the extent of land exposed on the Sunda Shelf. As Molengraaff (1921: 101) has stated, the first phase in the development of the surface of the Sunda Shelf occurred during the First Glacial Stage; subsequently it was exposed during each of the glacial maxima of the Pleistocene, and transgressed by the sea during each of the interglacial stages of high sea-level; by the close of the Fourth Glacial Stage, it was completely developed in the form in which it exists in a submerged state today.

[14] I.e. periods of *relatively* greater or *relatively* less rainfall in comparison with that of the present time.

[15] von Koenigswald, 1939*a*: 51.

[16] Compare von Koenigswald, 1935*a*; 1937*a*; 1939*a*.

[17] Matthew, 1929; Lewis, 1937*a*; Colbert, 1942; de Terra and Teilhard de Chardin, 1936; de Terra and Paterson, 1939.

[18] Compare de Terra, 1940*b*; 440–441; Movius, 1944: 87.

[19] von Koenigswald, 1937*a*: 27.

[20] Cosijn, 1931; Duyfjes, 1936; von Koenigswald, 1940: 47–51.

[21] From the vicinity of Modjokerto, near the type locality for the Djetis fauna in Eastern Java. See von Koenigswald, 1936*a*; 1936*b*; 1940: 47–51; Weidenreich, 1940*b*.

[22] Both from Sangiran, near Soerakarta, in Central Java (von Koenigswald, 1947; Weidenreich, 1942; 1944; 1945*a*; 1945*b*; 1945: 47–57; Hooijer, 1947; Vallois, 1946).

[23] For a complete and up-to-date discussion of the geology and paleontology of these beds, see von Koenigswald, 1940: 25–77.

[24] von Koenigswald, 1937*a*: 27. This fauna could have only migrated to Java via the Sunda Region during a stage of glacially-lowered sea-level.

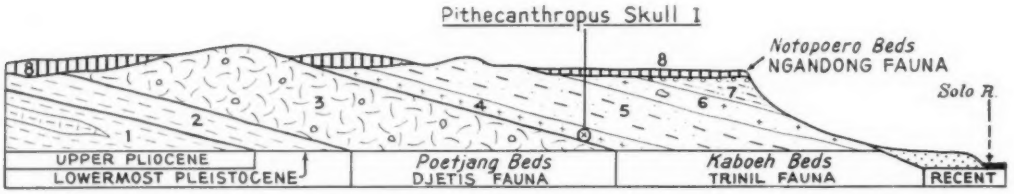


FIG. 1. Geological section at Trinil in the Solo Valley. (After Carthaus, 1911, and de Terra, 1943.) (1) Black clay with *Globigerina* marl; (2) Sandy clay; (3) Lahar conglomerate; (4) Bone-Bed; (5) Gray tuff, sandstone and silt with Plant-Beds; (6) Gray Sandstone with bones; (7) Gray sandy tuff; (8) Terrace sand and loam.

cooler climate—one similar to that of the present day in the monsoon-swept regions of Sikkim and Assam—obtained in Java at the time these beds were laid down.[25] This flora proves a mean annual temperature during early Trinil times some 6° to 8° F. cooler than at present. Furthermore, the nature of the clays indicates deposition during a period of torrential rainfall;[26] in other words, conditions were even more "pluvial" than they are today in this island. Since the second period of glaciation was the most severe on the Asiatic mainland,[27] it must have caused a lowering of the temperature and a relative increase in rainfall even in such tropical regions as Java. In each case, an early Middle Pleistocene horizon is being dealt with (see table 1 on pp. 346–347), a fact which makes such a correlation seem extremely plausible. On this basis, *Pithecanthropus erectus* is not First Glacial or First Interglacial, as some authorities have maintained, but Second Glacial—early Middle Pleistocene in terms of the Late Cenozoic stratigraphy in the Far East.

In Java the end of the Trinil Period is clearly defined by a marked unconformity caused by uplift and erosion. In spite of this break in the stratigraphic sequence, however, there is no pronounced faunal change between the *Kaboeh* Beds and the overlying *Notopoero* deposits, laid down during Upper Pleistocene times.

UPPER PLEISTOCENE

The Upper Pleistocene *Notopoero* Beds of Java contain the Ngandong fauna, abundantly represented in the terraces of the Solo River, as well as elsewhere in Central Java. Unquestionably the Solo terraces are directly related to fluctuations of ocean-level during the glacial stages of the Upper Pleistocene, but as yet the picture seems to be somewhat obscure as a result of contemporary tectonic movements in the Kendeng Hills.[28] Since human remains attributed to *Homo soloensis* have been found in the 20-meter terrace of the Solo near the village of Ngangdong,[29] associated with human artifacts (see p. 354), the importance of establishing the date of the three ancient stream levels in this valley is apparent. On the basis of the existing data, it is tentatively suggested that *H. soloensis* migrated to Java, along with certain new faunal elements, when the island was once again connected to the mainland of Asia. This presumably occurred during the period of the Third Himalayan Glaciation.[30] At this time the Sunda Shelf would have been dry land after having been submerged during the time of the preceding Interglacial Stage. It is possible that Wadjak Man, represented by the fossilized remains of two individuals found by Dubois in 1889–1890 imbedded in a conglomerate near Wadjak in Southeastern Java,[31] may be a Fourth Glacial immigrant to Java, unless this fossil hominid is to be regarded as an indigenous form. But the age of these interesting skeletal remains is admittedly uncertain, and the site where they were found has now been destroyed as a result of quarrying operations.[32] Since the type from a morphological point of view is far less primitive than Ngandong Man, the Wadjak specimens have tentatively been placed at the close of the Upper Pleistocene,[33] as shown on table 1.

[25] Schuster, 1909; 1911*a*; 1911*b*; Elbert, 1907; 1908; 1911; also de Terra, 1940*b*: 3–4; 1943: 449–452; Movius, 1944: 83.

[26] See Carthaus, 1911; Blanckenhorn, 1911.

[27] de Terra and Paterson, 1939: 229.

[28] Compare Elbert, 1909; Lehmann, 1936. In this connection it should be pointed out that Dr. de Terra's correlations of the various late Cenozoic horizons in Java with the glacial cycle of Northwestern India (de Terra, 1943) are *not* based on phases of river aggradation, as Zeuner has recently intimated (Zeuner, 1946: 276). Indeed, they are based on detailed observations at numerous excellent exposures in the field, as well as on long and painstaking palaeontological studies. The present writer, who was with Dr. de Terra the entire time he was in Java, can find no justification for Zeuner's claim.

[29] Oppenoorth, 1932*a*; 1932*b*; 1932*c*; 1932*d*; 1936; 1937; ter Haar, 1934; Vallois, 1935; van Es, 1933; von Koenigswald, 1933*b*; 1935*a*; 1937*a*; 1939*a*.

[30] de Terra, 1940*b*: 4; 1943.

[31] Dubois, 1921; Keith, 1921: 1932: 446; Pinkley, 1936.

[32] van Stein Callenfels, 1936*b*: 49.

[33] The fossil human skull found near Keilor, which lies 10 miles northwest of Melbourne, Victoria (Mahony, 1943*a*; 1943*b*; Wunderly, 1943; and Adam, 1943), may be accepted as fairly definite evidence that men of the Wadjak type migrated to Australia during late Upper Pleistocene times (compare Wood Jones, 1944; Keith, 1944). But even during the Fourth Glacial Stage when the continental shelfs of Sunda and Sahul were above the sea for the last time, the land connection between Australia and the Malay Archipelago was broken by more than one gap or strait. Therefore, some sort of sea-going raft, such as that used by the extinct Tasmanians, or a bark canoe, would have been necessary to negotiate a passage, as Tindale (1941: 144) has stated. In any case, the

POST-PLEISTOCENE

During Post-Pleistocene times, erosion and the formation of lateritic soils, comprising the superficial deposits of Java, took place under the conditions of a tropical climate. In many caves, associated with Mesolithic and Neolithic archaeological material, an essentially modern type of fauna, known as the Sampoeng fauna,[34] is found. Presumably, as in Northwestern India and Upper Burma (see pp. 337 and 342), the low silt terrace, found in the main valleys of the island, was formed at this time.

UPPER BURMA

Mainly as the result of the economic importance of oil, found at Yenangyaung and Chauk in the Irrawaddy Valley in Upper Burma (see map 1), the stratigraphy of the Tertiary Beds of that region is well established.[35] The uppermost deposits in the series, known as the Irrawaddian Beds, are mainly freshwater sediments, and they range in age from the Pontian (Lower Pliocene) to the Villafranchian (Lower Pleistocene). But the actual boundary between the Lower Irrawaddies, containing the so-called *Hipparion* fauna, and the Upper Irrawaddies, with *Elephas, Equus,* and *Leptobos* (Primitive Cattle), has not as yet been accurately established in the field. Several sections were observed by Drs. de Terra and Teilhard, however, which indicate that a structural unconformity exists between the lower and upper divisions of these 4,000 to 6,000-foot thick deposits.[36] Certainly a two-fold division is revealed by the fossil mammalian remains, as indicated above.[37] On this basis, the Lower Irrawaddies are regarded as the same age as the Middle Siwaliks of Northwestern India, while the Upper Irrawaddies are of Upper Siwalik (Lower Pleistocene: Tatrot—Pinjor) age.

LOWER PLEISTOCENE

As stated above, the fauna of the Lower Irrawaddies bears the same unmistakably Villafranchian stamp as the Upper Siwalik Beds (Tatrot and Pinjor Zones) of India. With only one exception—*Equus yunnanensis,* an immigrant from Southern China[38]—the Burmese forms are either identical with, or very closely related to, those found in the contemporary deposits of Northwestern India. In Burma, as in the Punjab (see p. 340), the Lower Pleistocene was brought to a close by an event, which, in comparison with subsequent geological events, was of major importance—a period of diastrophism. At this time, movements connected with mountain building led to the tilting of the Irrawaddian Beds (compare fig. 2), and a prolonged phase of peneplanation followed. This resulted in the formation of the tremendously extensive piedmont plain of Upper Burma.

MIDDLE PLEISTOCENE

During a major pluvial period, in all probability correlative with the Second Glacial Stage in the Himalayas,[39] thick deposits of gravel were laid down on the

present evidence from Java definitely does not support the view advanced by Mahony (1943*b*: 80–81) and Zeuner (1944) that Keilor Man reached Australia during the Third or Last Interglacial Stage. Thus Zeuner's correlation of a form of *H. sapiens* in Australia with *H. neanderthalensis* in Europe cannot be upheld (Zeuner, *op. cit.*). Indeed, as Professor Weidenreich (1945*c*: 30–31; 1947: 193–194) has shown, the morphological data clearly indicate that the Wadjak people of Java, a group considered to be physically intermediate between *H. soloensis* and the contemporary Australian aborigines (Weidenreich, 1939*c*: 111; 1943: 249–250), did not migrate to Australia before the Fourth Glacial Stage, as de Terra (1943: 462) has recently maintained.

[34] Dammerman, 1934.

[35] Noetling, 1895; Grimes, 1900; Pilgrim, 1910; Pascoe, 1912; Cotter, 1918; 1938; Stamp, 1922; Chhibber, 1934; Clegg, 1938; Evans and Sansom, 1941.

[36] de Terra, with Movius, 1943: 280–284.

[37] Compare Pilgrim, 1910; Colbert, 1938: 277; 1943.

[38] Colbert, 1940.

[39] de Terra, 1938*b*; 1939: 110; de Terra, with Movius, 1943.

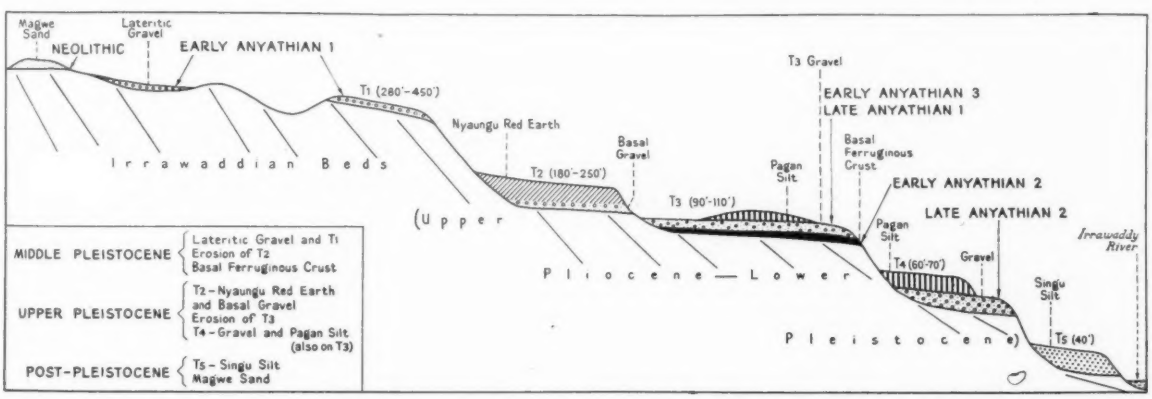


FIG. 2. Generalized cross-section of the Irrawaddy Valley showing the archaeological horizons in relation to the Terraces and Associated Soil Deposits. (Not to scale.)

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FIG. 3. The Pleistocene Terraces of the Irrawaddy Valley, Upper Burma. (1) The Terrace Sequence (T_1-T_4) south of Chauk. The Irrawaddy River is on the extreme left. (2) The main terrace (T_3) south of Yenangyaung. (3) Gravel pit on T_3 south of Chauk which yielded early Anyathian implements.

eroded surface of the Lower/Middle Pleistocene peneplain. On the basis of the characteristics of this gravel, called *Lateritic Gravel* by Dr. de Terra, it is estimated that at the time of its deposition the rainfall of Upper Burma was greatly in excess of that of the present day.[40] Stratigraphically the Lateritic Gravel is the counterpart of the Uru Boulder Conglomerate of Northern Burma,[41] and the uppermost Siwalik Boulder Conglomerate (Second Glacial Stage) of Northwestern India (see p. 340). Since the latter deposit is homogeneous throughout, and at the same time merges with the ground moraine of the Second Glaciation of Kashmir, the correlation suggested above may be regarded as a reliable base-line for establishing the age of the pluvial and interpluvial stages in Upper Burma in terms of the well-established Northwest Indian sequence.

The period of deposition of the Lateritic Gravel[42] was followed by a prolonged cycle of erosion, which be-

[40] The present annual precipitation in this area, the so-called "Dry Zone" of Upper Burma, is approximately 40 inches.

[41] According to Dr. de Terra (1944: 72), traces of glaciation are found in Northern Burma "north of the 27th parallel, where the relief becomes steeper, and where glaciers, remnants of formerly more extensive glaciation, exist. Boulder gravels and morainic debris issue from the tributary valleys, suggestive of glacial outwash on a scale incommensurate with the present restricted glaciation." (Compare Ward, 1921: 246 and 254; 1923: 11; 1932: 472–473; Stuart, 1923; von Wissmann, 1937*b*.)

[42] Unfortunately, the Middle and Upper Pleistocene terrace gravels of the Irrawaddy Valley have produced almost no

gan during a long dry interval, and which led to the cutting of T_1—an erosional terrace, the highest in the Irrawaddy system (see fig. 2; fig. 3, no. 1). It contains the earliest human artifacts—Phase 1 of the Early Anyathian—thus far discovered in Burma, and occurs at heights varying from 280 to 450 feet above the present level of the river. During this erosion period, all but a few scattered remnants of the Lateritic Gravel were removed from the peneplain. The dry interval when T_1 was cut was a prolonged erosion stage, and it is considered to represent a major Interpluvial Stage—the equivalent of the Second Interpluvial or Interglacial Stage in Northwestern India.

As the process of erosion continued during Second Interpluvial times, the river proceeded to cut a wide flat valley that was later partly filled with the deposits of T_2 and T_3. On this valley floor a cemented ferruginous crust was formed, which yields Early Anyathian (Phase 2) implements. At present this crust is exposed under T_3 at several localities; it occurs at a height of 90 to 110 feet above the river. That it was formed during a dry period when the stream was much reduced in size is demonstrated by the fact that the rock debris, as well as the implements which it contains, frequently display a typical desert patina, or varnish.

UPPER PLEISTOCENE

The second terrace (T_2) in the Irrawaddy Valley sequence is aggradational, and it was formed during a stage when the rainfall of Upper Burma was some two to three times that of the present, judging by the sedimentary characteristics of the deposits. As shown on the table (see p. 346), this stage has been correlated with the Third Glacial Stage of the Himalayas. In Upper Burma the T_2 deposits, which consist of a basal gravel overlain by 50 to 60 feet of slope-wash soil (Nyaungu Red Earth), are found in the form of wide benches 180 to 250 feet above the river. The T_2 basal gravels, now exposed on T_3, are rich in archaeological material stratigraphically referable to Phase 3 of the Early Anyathian culture.

By far the most conspicuous physiographical feature in the Irrawaddy Valley between Magwe on the south and Mandalay on the north is a wide terrace level 90 to 110 feet above the stream (see fig. 2; fig. 3, nos. 2 and 3). This is T_3 in the Pleistocene succession of Upper Burma; it was formed during a dry Interpluvial Stage, the counterpart of the Third Interglacial in the Himalayan sequence. This terrace, therefore, is an erosional terrace. On T_3 the basal ferruginous crust of Second Interpluvial age is usually overlain by fluvial gravels and sands. These latter deposits are actually of T_2 age (Third Pluvial), and they comprise the main Early Anyathian implement-bearing horizon.

The Fourth Pluvial Stage, which belongs chronologically to the late Upper Pleistocene, led to the formation of T_4, an aggradational terrace found at a height of 60 to 70 feet above the river. The gravels and sands laid down at this time contain slightly rolled implements typical of the Late Anyathian culture,[43] as well as derived and heavily rolled Early Anyathian material from the higher terrace horizons. A mantle of loessic silt, called the Pagan Silt, overlies the water-laid deposits of T_4. Several feet of this same structureless eolian silt are also found overlying T_3 at some localities (see fig. 1). It is the equivalent of the Potwar Silt of Northwestern India,[44] and may be considered a sort of "pluvial loess" that is typical of the semi-arid areas of the monsoon-swept regions south of the Himalayan massif.

POST-PLEISTOCENE

A low silt terrace (T_5), some 40 feet above the river, was formed during the Recent Stage. It contains Neolithic and later archaeological material, and it has a very close equivalent in the low silt terrace (T_5) of the Punjab (see p. 342). Also at this time the so-called Magwe Sand, associated with which Neolithic camp-sites were discovered,[45] was laid down on the peneplain.

NORTHWESTERN INDIA

Recent detailed geological investigations of the Late Cenozoic deposits in the Kashmir and Punjab Provinces of Northwestern India (see fig. 5, nos. 1 and 3) by Drs. de Terra, Teilhard de Chardin, and Paterson have resulted in the firm establishment of a four-fold glacial cycle in that region, as well as in the discovery of a new Lower Palaeolithic culture, the *Soan*.[46] Over a century

mammalian fossils. Those that do occur all seem to be derived from the underlying Irrawaddian Beds. At Mogok in the karst region of the Northern Shan States, however, a fairly rich Middle Pleistocene assemblage, including *Aeluropus, Stegodon, Elephas,* Deer, and Porcupine, has been recorded (Teilhard, with de Terra and Movius, 1938; Colbert, 1943: 417–421).

[43] Movius, 1943: 372–374.

[44] Described in detail by de Terra, with Paterson, 1939: 274–276.

[45] Movius, 1943: 382–386.

[46] de Terra, 1933*b*; 1935; 1936; 1937*a*; 1937*b*; 1938*c*; 1939; 1940*a*; de Terra and Teilhard, 1936; de Terra, Teilhard, and Paterson, 1936; de Terra and Paterson, 1939. Certainly the greatest significance of the contribution made by Drs. de Terra, Teilhard de Chardin, and Paterson to our knowledge of the Pleistocene of this area lies in the fact that their work has now made it possible to extend the well-established glacial cycle of Kashmir into the river valleys of the adjacent plains (e.g. the Soan and the Indus), and thereby to provide a basis for dating the rich implementiferous horizons associated with the various terrace levels in terms of the periods of mountain glaciation. Actually the first evidence for the existence of an Ice Age in the Kashmir Himalaya was recorded by Godwin-Austen (1862; 1880), Drew (1873), Theobald (1873; 1878) and Lydekker (1879: 29–32; 1883: 33–41); their observations were supplemented by those of Stiffe (1890), Oldham (1904), La Touche (1910), and Middlemiss (1911: 123–124). In 1913–1914 the Italian geologist Dainelli (1923, *in Italian;* see review articles by Garwood, 1924; and Loewe, 1924) identified for the first time four main oscillations of the climate in the glacial cycle of Kashmir; these were later confirmed and elaborated on by

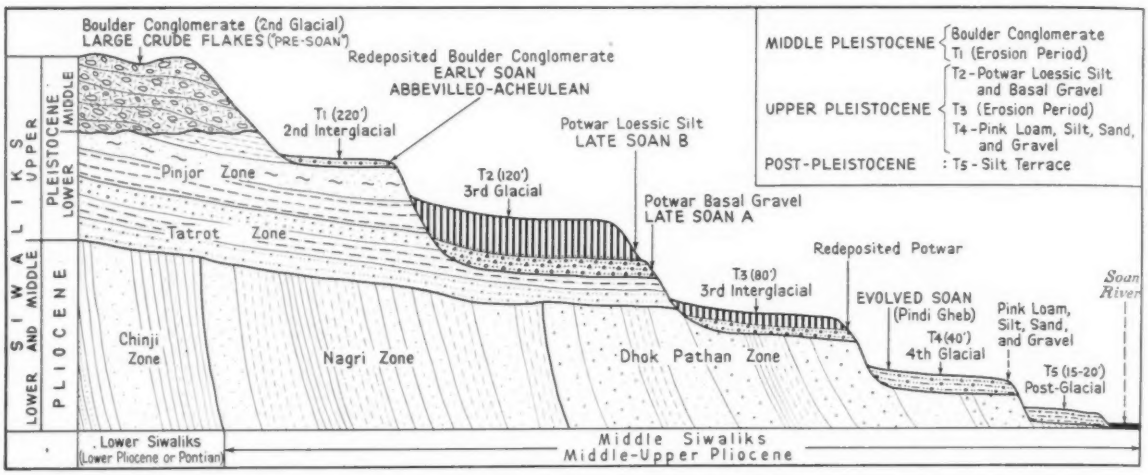

FIG. 4. Generalized cross-section of the Soan Valley showing the archaeological horizons in relation to the Terrace Deposits and the underlying Siwalik Beds. (Not to scale.)

ago research in the Tertiary and Pleistocene beds of this area was first begun, and it is closely linked with the names of Falconer, Cautley, Lydekker, Middlemiss, Oldham, and Pilgrim, while more recently Matthew, Colbert, and Lewis[47] have contributed additional information based on new collections of fossil mammals, including anthropoids,[48] from the famous beds exposed in the Siwalik Hills (see map 1). The sequence of these beds, which comprise over 20,000 feet of freshwater deposits and range in age from Upper Miocene to early Middle Pleistocene, may be summarized as follows:

III. *Upper Siwaliks*
- Boulder Conglomerate Zone: early Middle Pleistocene
- Tatrot Zone, Pinjor Zone } Lower Pleistocene (Villafranchian)

II. *Middle Siwaliks*
- Dhok Pathan Zone: Upper Pliocene
- Nagri Zone: Middle Pliocene

I. *Lower Siwaliks*
- Chinji Zone: Lower Pliocene (Pontian)
- Kamial Zone, Murree Zone } Upper Miocene

The sedimentary characteristics of, as well as the evidence of the fauna from, the late Middle Siwaliks (Dhok Pathan Zone) demonstrate that, as the Pliocene was drawing to a close, the country south of the Himalayan massif was becoming drier and less tropical. As indicated on the section (fig. 4), there is a marked disconformity separating the Middle Siwaliks (Nagri and Dhok Pathan Zones) from the lowermost Upper Siwaliks (Tatrot and Pinjor Zones).[49] This was a period of uplift and mountain-building; it initiated a prolonged cycle of erosion and peneplanation. Since a considerable period of time must be actually represented by this unconformity, it is possible that the stratigraphic hiatus covers at least a part of the Upper Pliocene.[50] In any case, this stage of uplift put an end to the cycle of sedimentation which had

de Terra, Teilhard, and Paterson, as stated above, as well as by Wadia (1938). In the meantime, both Norin (1925; 1926) and Grinlinton (1928) working independently of the Italian Expedition during the twenties had arrived at the conclusion that more than one glacial phase had occurred in the Kashmir area during Pleistocene times.

[47] Matthew, 1929; Colbert, 1935; Lewis, 1937*a*.

[48] Lewis, 1934; 1936; Gregory, Hellman, and Lewis, 1938. To date the total finds of fossil anthropoids in India (including Burma) number 82, representing some 11 genera and about 21 species, according to Wadia and Aiyengar (1938). As Lewis (1937*b*: 139) has stated, "when it is remembered that the Siwalik higher anthropoid remains found to date practically are restricted to the Chinji and Nagri formations, this relatively large fauna would seem incredible. The numerous species have been established, in all probability, due to the very fragmentary nature of the fossil record. Genera and species have been founded on the basis of single and imperfect teeth. This is to be expected in the case of forms so rarely found and which, when they are discovered, usually consist of incomplete fragments of jaws and teeth." Until more complete fossil anthropoid material has been recovered from these same deposits, however, there seems to be no way out of the existing dilemma.

[49] Compare Pilgrim, 1910; 1913; de Terra and Teilhard, 1936; de Terra and Paterson, 1939.

[50] If the period of time necessary to form the erosion surface represented by the unconformity is long, the actual time interval is *in* this erosion period. Consequently, it is not clearly defined. The stratigraphic definition is easily recognized in the field, but it is not apparent, nor can it ever be apparent from point of fact, unless beds are found which actually bridge the unconformity. The implications of this observation as regards the "comparatively sudden" introduction of the Villafranchian fauna are obvious. Although apparently representing a relatively shorter period, this same comment also applies to the erosion interval separating the Lower Pleistocene (Pinjor Zone) from the Middle Pleistocene (Boulder Conglomerate Zone), shown on the section (fig. 4) and discussed on p. 340.

prevailed in the Potwar Region from Upper Miocene times.

LOWER PLEISTOCENE

Following Haug's definition of the Pleistocene,[51] it is now generally agreed by most of the leading authorities that, on the basis of climatic, faunistic, and geological evidence, the Upper Siwalik Tatrot and Pinjor Zones belong in the Lower Pleistocene,[52] which accords with Dr. Hopwood's conclusions based on palaeontological studies of material from other localities in the Old World.[53] Now the fauna, known mainly from the Pinjor Zone, is a typically Villafranchian assemblage, and it includes *Elephas, Equus, Bos,* and *Camelus.* Although the Tatrot fauna contains some Dhok Pathan survivals, there is a fairly abrupt break in the Siwalik sequence at this time from a palaeontological point of view. That the Tatrot deposits were laid down during the stage of the First Glaciation in the Kashmir Himalayas is demonstrated by the following critical evidence:

(*a*) The petrographical analysis of a sample of clay from the Tatrot Zone, collected at Naushahra in the Salt Range, reveals the presence of quartz, most of which "is angular, some of it extremely so, forming splinters (Cayeaux's éclats), suggestive of glacial action." [54]

(*b*) In the Poonch Valley on the southern slope of the Pir Panjal Range the basal Tatrot gravels contain many foreign pebbles and far-traveled boulders.[55]

(*c*) The basal conglomerate of the Tatrot Zone, together with the overlying sandstone with silt layers interspersed, approximately 1,000 feet thick, reveals a deltaic structure that "must have required powerful streams and abundant rainfall. . . . The Tatrot Stage was in fact the sedimentary precipitate of a process dominated by uplift of the surrounding highlands and promoted by moist climatic conditions." [56] That increased rainfall did not lead to the "formation of red beds or even of a noticeable amount of decayed matter suggests in its turn a lowered temperature," as Dr. Krynine has stated.[57]

(*d*) The cemented gravels, known as Malshahibagh Conglomerate, laid down during the stage of the First Glaciation of Kashmir, contain the same Villafranchian forms as those found in the Tatrot Beds of the neighboring Himalayan foothills.[58]

(*e*) In comparison with the fauna of earlier Siwalik times, and also with that of the succeeding Pinjor Zone, the Tatrot fauna is greatly impoverished,[59] reflecting a climate that was definitely temperate and cooler than previously. Dr. Colbert [60] lists only 11 species from the Tatrot, as compared with 89 from Pinjor and 102 from the preceding Dhok Pathan Zone. As Dr. de Terra has stated,[61] "this reflects the impact of the glacial climate on the rich mammal faunas of the Siwaliks."

(*f*) The sedimentary characteristics and the stratigraphic position of the Lower Karewa Beds, which lie between the terminal moraines of the First Glaciation and the Second Glacial deposits in the Sind Valley (Kashmir) and are therefore of First Interglacial age, indicate that these lacustrine deposits are in fact the mountain equivalent of the Pinjor Zone of the Upper Siwaliks. Indeed, the lake-loess and silt deposition found in both cases corresponds to a very striking degree.[62]

Thus soil analysis, climatic evidence, palaeontological data, and the geological composition of the beds themselves (as well as the evidence of the immediately overlying deposits) all favor the view that the Tatrot Zone of the Upper Siwaliks is correlative with the First Glacial Stage in Kashmir.[63] On this basis, the earli-

[51] Haug, 1911: 1161.

[52] Matthew, 1929; Colbert, 1938; 1942; Lewis, 1937*a*; de Terra and Teilhard, 1936; Simpson, 1945: 167.

[53] Hopwood, 1935*a*; 1936*a*; 1936*b*; 1940.

[54] Krynine, in de Terra and Paterson, 1939: 238.

[55] Paterson, with de Terra, 1939: 212.

[56] de Terra, with Paterson, 1939: 260. See also Paterson, 1941: 394.

[57] Krynine, 1937: 444.

[58] de Terra, with Paterson, 1939: 214; de Terra, 1939: 102.

[59] Compare Pilgrim, with Hopwood, 1938: 450.

[60] Colbert, 1935.

[61] de Terra, with Paterson, 1939: 224.

[62] de Terra, with Paterson, 1939: 214 and 261–264; Krynine, in de Terra and Paterson, 1939: 241–243.

[63] In a recent paper, published posthumously, the late Dr. Pilgrim (1944: 30–33), who was unquestionably at the time of his death the greatest contemporary authority on the faunas of the Siwalik deposits, advanced the interesting hypothesis that the so-called Bain Boulder Bed, identified in the Marwat Formation of Waziristan, Northwest Frontier Province (Morris, 1938), and thought to be of Pinjor or (?) later age, does in fact represent a deposit of the First Glacial Stage in Kashmir. Possibly it does, but that such a correlation is even likely cannot be proved on the basis of present evidence, and it may well be that this boulder bed is of Second Glacial age. Not only is Waziristan some 250 miles west of the glaciated tract that was studied by Drs. de Terra, Teilhard de Chardin, and Paterson, but also the Late Cenozoic succession of the former region has not as yet been worked out in sufficient detail to permit definite correlations with the well-established Siwalik sequence. In any case, the correlation proposed by Pilgrim, although it has been accepted by Zeuner (1945: 175; 1946: 274–275), has yet to be demonstrated in the field. If the joint conclusions arrived at by Drs. de Terra, Teilhard, and Paterson are wrong, surely this sort of a compilation of assumptions is not a sound method of proof. Furthermore, Pilgrim's suggested subdivision of the late Middle Siwalik Boulder Conglomerate into two alleged zones—upper zone = Second Glacial, and lower zone = First Interglacial—definitely cannot be substantiated nor do they exist in the field, according to information received from Dr. de Terra. Indeed, Pilgrim's scheme, on the basis of which the Tatrot and Pinjor

est ice-advance in the Himilayas is referable to the Pleistocene when the new Villafranchian fauna appeared in Northwestern India.

The sedimentary characteristics of the overlying Pinjor Zone of the Upper Siwaliks prove that deposition was taking place by the action of sluggish meandering rivers flowing at that time in wide flood plains. The Pinjor faunal assemblage demonstrates that this was a period when there was a warm temperate climate with a rich vegetation. Likewise, the composition of the First Interglacial (Lower Karewa) beds of Kashmir indicate that they were laid down during a period of climatic and crustal stability (see p. 339).[64] This supports the view that the Pinjor Zone is of the same age and should be assigned to the First Interglacial Stage in terms of the Himalayan sequence, as shown on the table (see p. 346). As far as Northwestern India is concerned, there is no doubt that pluvial stages in the periglacial region of the Potwar Plateau correspond to glacial stages in the Kashmir Himalayas, and that interpluvials are in turn the equivalent of the interglacials of the mountainous tracts.[65]

MIDDLE PLEISTOCENE

Following the accumulation of the Pinjor beds, a second major stage of folding and erosion occurred in the Sub-Himalayan region. This was caused by uplift in the mountains. As shown on the section (fig. 4), this event marks the boundary between the Lower and Middle Pleistocene in Northwestern India. In the mountains these movements seem to be connected with the second glacial advance, the most extensive glaciation of Kashmir, when huge boulder fans that locally attain a thickness of 5,000 feet were laid down in the adjoining foothills and on the plains. Although these deposits, which contain boulders up to 3 feet in diameter and which are known as Boulder Conglomerate, yield a typically Middle Pleistocene fauna, analogous to that of the Narbada and Godavari Valleys of peninsular India,[66] they are nevertheless included in the Siwalik Series. During this period of maximum ice-advance, uplift continued in the Himalayan tract.[67] Precipitation was heavy in the Potwar Region at this time, and the transporting power of the streams was greatly in excess of that of the present day. Since Drs. de Terra, Teilhard, and Paterson have proved that the enormously thick Boulder Conglomerate (late Upper Siwalik) is in fact an outwash boulder fan accumulation that merges into the fluvio-glacial gravels that are associated with the ground moraine and Karewa Gravel of the Second Glaciation of Kashmir, there is absolutely no question concerning the correlation between this late Upper Siwalik Zone with the glacial cycle of the Himalayas. Now at some ten localities in the Punjab implements of the so-called "Pre-Soan" flake industry have been discovered in the upper layers of the Boulder Conglomerate (see pp. 376–377); therefore this positive dating of this horizon is of prime importance. Furthermore, it fixes the maximum age of the terraces in the Punjab Valleys, including those of the Soan and Indus Rivers, in terms of the well-established Kashmir sequence. Thus, on the basis of existing data, the earliest human occupation of the region occurred in early Middle Pleistocene (late Second Glacial) times.

Prolonged and widespread erosion ensued during the Second Interglacial or Interpluvial Stage, which led to the cutting of T_1, a degradational terrace found some 220 feet above stream-level in the Soan Valley (fig. 4; fig. 5, no. 3). Uplifts of the Himalayan tract were still going on, a factor that caused tilting and folding of the Boulder Conglomerate[68] and contributed to the dissection of the Potwar peneplain. The surface of T_1 is covered with gravel—redeposited Boulder Conglomerate—which in some places has become cemented. That dry conditions prevailed is demonstrated by the occurrence of eolian sediments in the Second Interglacial deposits (Upper Karewa Beds) of Kashmir. Associated with the fluvial gravels on T_1, Early Palaeolithic implements—both Abbevilleo-Acheulian (hand-axes) and Early Soan (choppers and chopping-tools)—are found at numerous localities in the Punjab. Their rolled condition indicates that they were manufactured in the area during Second Interpluvial (or Interglacial) times and later deposited in the T_1 sediments. In any case, there is no evidence to support the view that they were derived from the Boulder Conglomerate of the Second Glacial Stage.

UPPER PLEISTOCENE

The second terrace (T_2) in the Punjab sequence is an aggradational terrace; it is found at a height of some 120 feet above the Soan River. That it was formed during the time of the Third Glaciation of Kashmir is demonstrated by the fact that it can be traced in

Zones are retained in the Pliocene, reveals a considerable degree of variance from recent, competently observed and fully recorded scientific facts. In this connection, it should be mentioned that the flaked pebbles from the Bain Boulder Bed in Waziristan, which are supposed to be human implements (Morris, 1938: 401–402 and fig. 5; Coulson, 1938: 433–434) and which the writer saw in Calcutta in 1937, are extremely doubtful specimens; they should not be regarded as evidence of a Palaeolithic occupation of this area during Lower Pleistocene times.

[64] In addition to containing abundant remains of a fossil flora of alpine type (see Middlemiss, 1911: 120–122; Wodehouse, 1935; de Terra, with Paterson, 1939: 118–120), the Lower Karewas have been strongly tilted subsequent to the time of their deposition (see Lydekker, 1878: 31–34; Middlemiss, 1924: 246; Wadia, 1938: 195; de Terra, with Paterson, 1939: 127–130).

[65] Compare Nilsson, 1941.

[66] de Terra and Teilhard, 1936: 811–820; de Terra and Paterson, 1939: 266 and 318; Theobald, 1860; Pilgrim, 1905: 213–216.

[67] Coulson, 1938.

[68] Wadia, 1938: 197.

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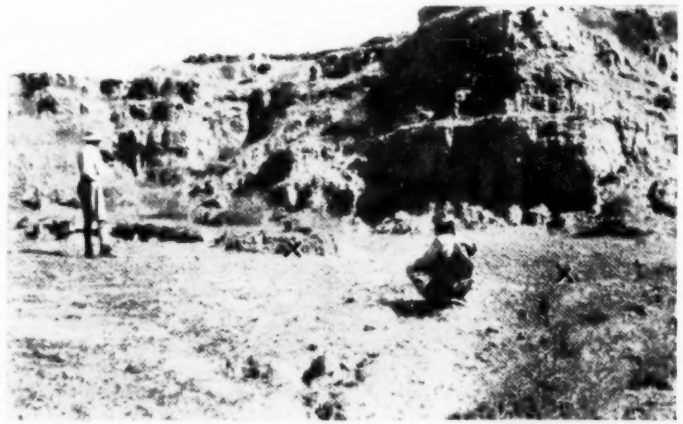

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FIG. 5. Terrace stratigraphy and archaeological sites in Northwestern India. (After de Terra and Paterson.) (1) Glacial terrace sequence at the outlet of the Vishav River, near Sedau, Kashmir. T_1, T_2, etc.—terraces. G_3—Third Glacial deposits. LK—Lower Karewa Beds. (2) Late Soan workshop (S) between Potwar Loessic Silt and Potwar Basal Gravel on T_2 near Chakri, Soan Valley. (3) Right slope of the Soan Valley, near Bandhar, Panjab Province. (4) Late Soan B workshop (X) at the base of the Potwar Loessic Silt on T_2 at Pir Abdul, near Gila Kalan, Soan Valley.

the tributary valleys issuing from the Himalayan foothills up to the terminal moraines resulting from this stage of ice-advance. At many localities the fluvial gravels exposed on T_2, known as the Potwar Basal Gravels, contain implements referable to Phase A of the Late Soan culture. In the lower 20 feet of the overlying Potwar Loessic Silt (fig. 5, nos. 2 and 4) Late Soan B implements and workshops were discovered at numerous places. This silt, which is not a true loess but rather a precipitate of the semi-arid monsoon regions south of the Himalayas, has been described in detail elsewhere.[69] Since at some exposures this Loessic Silt is slightly tilted, the possibility of a late movement in Post-Potwar times cannot be ignored.

During the long and comparatively dry stage of erosion which followed, a degradational terrace (T_3), at a height of about 80 feet, was formed. On it redeposited Potwar sediments are exposed in the valleys of the Punjab. This same erosion stage is also clearly defined in Kashmir (fig. 5, no. 1), and it seems patently clear that it originated during the Third Interglacial (or Interpluvial) Stage, as shown on the table (see p. 346). At this time the sedimentation of wind-borne, loessic silt apparently continued throughout the entire area.

A very slight crustal movement during late Upper Pleistocene times resulted in a minor phase of uplifting in the Potwar Region; this initiated a cycle of stream-cutting which is recorded by a rather prominent slope in the Punjab Valleys between T_3 and T_4. Actually the latter, a 40-foot terrace, represents a fill stage contemporaneous with the fourth ice-advance in Kashmir. Associated with this depositional terrace, a localized and highly evolved Soan industry was discovered.[70] This evidence shows that the Lower Palaeolithic chopper—chopping-tool tradition persisted in the Punjab as late as the Fourth Glacial Stage of the Himalayas.

POST-PLEISTOCENE

A low flood terrace (T_5) some 15 to 20 feet above stream-level has been assigned to the Post-Pleistocene Stage in Northwestern India by Dr. de Terra. Such a dating is in complete agreement with the evidence from Upper Burma, where a very similar terrace containing Neolithic and later objects was observed in the Irrawaddy Valley (see p. 337). Although no archaeological material was found in T_5 of the Punjab, Dr. Zeuner's suggestion[71] that this terrace may have been formed during late Upper Pleistocene times seems extremely unlikely on the basis of the existing data.

[69] de Terra, with Paterson, 1939: 271–276; summarized in Movius, 1944: 22.

[70] de Terra and Paterson, 1939: 295 and 311.

[71] Zeuner, 1946: 273–274.

NORTHERN CHINA

The region under consideration, known as the *North Tsinling Quadrangle*,[72] lies south of the Mongolian Plateau and north of the Tsinling Shan, a range of mountains which runs east-west and which has divided China into two geographical provinces since late Tertiary times.[73] This quadrangle includes the basin of the Huangho or Yellow River as shown on the map (map 1). As the result of much intensive work done during the past twenty-five years by Andersson, Barbour, Bien, Licent, Pei, Teilhard de Chardin, Young, and others, the stratigraphy of the Late Cenozoic Stage in this region seems to be reasonably well established. Thus far, however, no serious attempts have been made to fit the clearly defined terrace system of the Huangho (Yellow River) Valley[74] into this sequence. Furthermore, the relative age of the Pleistocene deposits of Central and South China, including the terraces of the Yangtze River,[75] have not yet been clearly established in terms of the recognized stratigraphy of the Hopei Region.

In general, the Pliocene was a long period of lake deposition when tropical or subtropical conditions obtained.[76] The Paote Beds (Lower Pliocene: Pontian) contain the so-called *Hipparion* fauna,[77] and, from a geological and palaeontological point of view, it was at this time that modern China began. During this period, the main lines of the freshwater basins, which did not change essentially thereafter, were established in Northern China.[78] In contrast with Northwestern India, the presence of fossil Primate material in any Tertiary deposits in China is exceedingly rare; therefore, as Dr. Teilhard has stated,[79] "in spite of the brilliant speculations of Dr. Davidson Black[80] and others, there is no objective support at present for the theory that Man originated north of the Himalayas." The deposits of the Yüshê Beds (Upper Pliocene) indicate a distinct step in the direction of increased aridity—the lakes became smaller and the fauna included a rich

[72] Teilhard, 1941: 4.

[73] Young, Bien, and Mi, 1943.

[74] Teilhard and Young, 1930; Barbour, 1933*a*; 1933*b*.

[75] Barbour, 1935*a*; de Terra, with Movius, 1943: 330–332; Hanson-Lowe, 1938; 1939; Teilhard, 1941; Teilhard and Young, 1935; Teilhard, Young, Pei, and Chang, 1935.

[76] Compare Teilhard, 1937*a*; 1938*a*; 1941: 2–11.

[77] Black, Teilhard, *et al.*, 1933: 24–26; Teilhard, 1941: 8–10.

[78] Teilhard and Young, 1930: 24.

[79] Teilhard, 1941: 55. In China, one of the richest and best known fossiliferous areas in the Old World, the only Primate remains found to date in any of the Cenozoic horizons are the following: (*a*) two questionable Lemuroid types (*Hoanghonius* and *Adapidium*) from the Upper Eocene of Northern Honan; (*b*) a Baboon (*Cynocephalus*) from the Lower Pleistocene (Villafranchian) fissure at Choukoutien: Locality 12 (see p. 389); and (*c*) the abundant remains of Orang from the Middle Pleistocene fissure deposits of Southern China. According to Dr. Teilhard (*loc. cit.*), "'*Pliopithecus*' *posthumus* Schl., from the Middle Pliocene of Mongolia, is based on a single, completely worn out, and therefore utterly unreliable upper molar."

[80] Black, 1925.

grazing and browsing assemblage.[81] This period was brought to a close by diastrophic movements, involving both surface warping and normal faulting, which led to an erosion interval, known as the Fenho Erosion Stage (see fig. 6).[82] Thus, as in Northwestern India, the Plio-Pleistocene boundary is clearly defined in Northern China.

PLEISTOCENE: GENERAL

The headwaters of both of China's great rivers—the Huangho and the Yangtze—rise in regions that are known to have supported ice-sheets during Pleistocene times,[83] a fact which indicates that there is a solid basis for the contention that the climatic fluctuations which occurred during that epoch in China are similar to and synchronous with those established in the lands to the southwest bordering on the Tibetan Plateau and the great Himalayan Range.[84] However, at present, the data bearing on the question of Pleistocene glaciation in China are extremely meager, especially in view of the very extensive field-work that has been done on the Late Cenozoic problems of that country. This has resulted mainly from the failure of many Chinese and European scientists working in that country to recognize the existence of a glacial cycle in the mountain areas of the Far East, of which the various Pleistocene deposits of the region represent the geologic precipitates. Although the valleys and plains of Eastern Asia were never actually covered with ice during the time of the various glacial maxima of the Pleistocene, as were comparable portions of Europe and North America, the following critical facts establish the existence of Quaternary glaciation(s) in the highlands bordering China proper, as well as in certain high mountain areas within the region under discussion, beyond all cavil:

(*a*) That substantial quantities of ice were present in the mountainous regions adjacent to the North Tsinling Quadrangle during Upper Pleistocene times may be inferred from the evidence of the sediments laid down during the stage represented by the Fourth Glaciation in this portion of the Far East. For the presence of this ice exerted a profound influence on the climatic factors controlling depositionary processes within that area. This fact is clearly shown by the distribution of the Malan Loess and associated deposits[85] (Nanking Loessic Loam or Siashu Loam), found in Northern, Central, and Southern China—sediments that could only have accumulated under climatic conditions which differed from those obtaining at the present time in the lower sections of the Huangho and Yangtze Basins. Indeed, the distribution of these sediments demonstrates that at the time of the maximum of the last glaciation the great semiarid region to the west of China proper shifted south by about four degrees.[86] Therefore, at this time Northern China would have possessed a definitely continental type of climate with a prevailing northwest wind, like that of parts of Inner Mongolia today, and relative cool, dry steppe conditions would have prevailed. This would have been contributed to by the contemporary stage of low sea-level (see below), which would have cut off much of the area from the moderating effect of the oceanic easterlies, now dominant in Northern China during about half the year. During the interglacials, on the other hand, the climate would have been relatively moist and temperate, or even in part tropical, conducive to the formation of *terra rossa* and other types of weathered soils.

(*b*) It has been proved that all the important mountain ranges in Central Asia and the Tibeto-Chinese border region of Western Szechwan and Yunnan, as well as the principal peaks of Northern China, Korea, Japan, and Formosa, nourished either ice-sheets or local glaciers during Pleistocene times.[87]

(*c*) No less than three separate glaciations—the *Poyang* (oldest and most extensive), the *Taku*, and the *Lushan*—have been recorded in the Lu-

[81] Teilhard, 1937*a*; 1937*b*; 1941: 7–9.

[82] Whereas the so-called Fenho Erosion Stage is a clearly defined stratigraphic boundary separating the Upper Pliocene and the Lower Pleistocene deposits in Northern China, the actual time interval involved is not apparent. This is also true of Northwestern India (see footnote 50 on p. 338), and of the Lower/Middle Pleistocene erosion interval, called the Huangshui, in Northern China (see p. 345).

[83] Recently no less than three major glacial stages have been identified in Chinese Turkestan (see Huang, 1944).

[84] Likewise, it seems reasonable to expect that Post-Pliocene epirogenic movements of the Himalayan system should have their counterparts in the Far East. The fact that such movements did occur in Western Yunnan and in the Tarim Basin has already been indicated by Misch (1945) and Norin (1935), although the precise dating of the uplifts in question has not yet been established. For an excellent bibliography containing many additional references to the Late Cenozoic geology and glaciation of Central Asia, the border regions of Tibet and Western China in general, see Tseng, 1946.

[85] Thorp, 1935*a*: 129–131.

[86] von Wissmann, 1938*a*; 1938*b*; 1938*c*; also de Terra, 1941: 17–18; Movius, 1944: 57–58. In this connection, it is pertinent to note that in Central Japan an exceedingly rich fossil flora has been identified from the sediments of an ancient lake, apparently of Late Glacial age (Endo, 1933). According to Endo, the evidence of this flora proves that during Late Pleistocene times the mean annual temperature of this area was some 5° to 6° Centigrade cooler than it is at the present time.

[87] Andersson, 1939: 45–73; Antevs, 1928: 4–5; 1929: 686–690; Bien, 1940: 198; Berkey and Morris, 1927*a*; 1927*b*; de Terra, 1941: 5; Flint, 1947: 366–367 and 370–371; Harland, 1945: 5; Heim, 1936; Hanson-Lowe, 1947; Imamura, 1937; Kano, 1934; 1935; 1937; Kuo and Yeh, 1944; Lee, 1922; Misch, 1945: 107; Norin, 1932; Olbricht, 1923; Oseki, 1914; 1915; Penck, 1934; Richardson, 1943; Sasa, 1934; 1936; Sasa and Tanaka, 1938; Schwind, 1935; 1937; von Wissmann, 1937*a*; 1937*b*; 1938*a*: 213; Yamasaki, 1922; Ward, 1916; 1922.

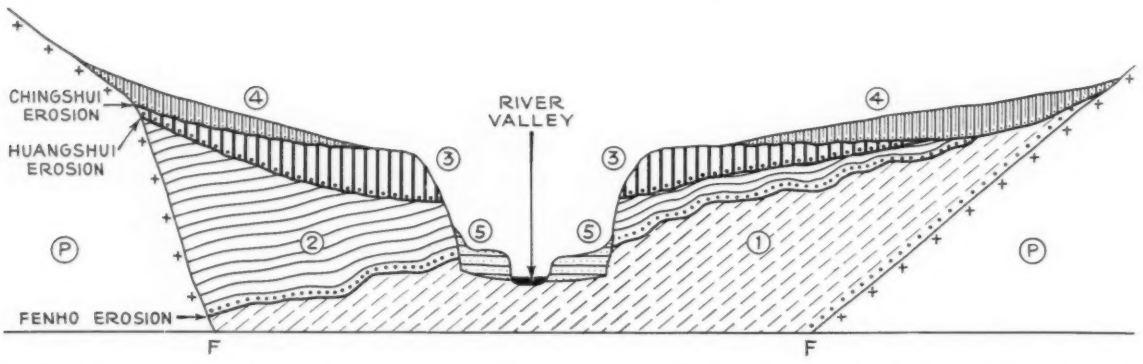

FIG. 6. Schematic diagram showing the structure of a Late Cenozoic Basin in Northern China. (After Teilhard, 1938*a*.) F—Fault; P—Palaeozoic rocks; (1) Pliocene deposits; (2) Lower Sanmenian (Villafranchian) Beds: Lower Pleistocene; (3) Choukoutien Red Loam and Basal Gravel: Middle Pleistocene; (4) Malan Loess and Associated deposits: Upper Pleistocene; (5) Panchiao Alluvium.

shan Region of Northeastern Kiangsi, where evidence for local glaciation was likewise recognized in several other mountainous areas—Northwestern Kiangsi, Western Hunan, Western Hupeh, and Southern Anhui—in Southern China.[88]

In China, as elsewhere in Southern and Eastern Asia, the level of the ocean must have fluctuated in tune with the rhythm of the various advances and retreats of the ice.[89] Thus it is not surprising to find that evidence for a period of high sea-level has been recorded in East-Central China (Hangchow area),[90] while in the vicinity of Nanking deposits of loess, the same age as the Malan Loess, have been found some 35 meters below the present level of the ocean.[91] In addition, drowned valleys and submarine terraces between Korea and Japan, in the region of the Yellow Sea, and in the Straits of Formosa, as well as extensively developed high-level marine beaches in Northern Japan, afford further proof of former stages when the level of the sea relative to that of the land was fluctuating.[92] These facts indicate that there is an urgent need for further work on this problem. In any case, if parts of China were glaciated and the sea-level was lowered during the time of the last glacial maximum, there is very little doubt that all four of the Pleistocene glaciations, recognized in Northwestern India, exerted a profound influence on the climate of the Far East. With this concept in mind, it is interesting to consider the evidence of the Pleistocene deposits in the region of the North Tsinling Quadrangle for the purpose of determining whether or not it is possible to date the early human remains, and associated Stone Age cultures, found there in terms of the four-fold climatic curve established in the Himalayan region to the southwest.

VILLAFRANCHIAN

The diastrophic movements that occurred at the end of the Pliocene led to a partial displacement of the lakes and initiated an erosion interval, known as the Fenho Erosion Stage (see fig. 6), which is a very clearly defined physiographic stage.[93] It has been recorded at the base of the following deposits: (*a*) the Taiku Beds of Central Shansi, (*b*) the Sanmenian Beds of the Huangho Basin in Northern Honan, (*c*) the Nihowan Beds in the Sangkanho Valley of Northern Hopei, and (*d*) the Sanmenian Beds of the Yüshē Basin of Central Shansi.[94] At each locality, the lower horizons of these beds contain an essentially Villafranchian-type fauna, including *Elephas, Equus, Bos, Paracamelus* (a large Camel), *Cervus,* and *Ovis*.[95] Known collectively as the Sanmenian Series, it is now recognized that these beds do not form a single stratigraphic unit. Indeed, there is a distinct unconformity, marked by an erosional contact (Huangshui Erosion

[88] Lee, 1933; 1934; 1936; 1938; 1939; Li and Wu, 1940; Sun, 1944. Although the evidence for the Yangtze Valley Glaciations has not been accepted by Drs. Teilhard (1941: 27 and 43) and Barbour (1934; 1935*a*: 103), both Dr. von Wissmann (1937*a*: 150) who is an experienced glacial geologist and Professor P. Misch (personal communication) state that from their own observations and investigations they are convinced of the correctness of Professor Lee's interpretations. In this connection, it should be mentioned that in the mountains of Western Yunnan, Professor Misch apparently has secured conclusive evidence of three glacial stages (*unpublished:* personal communication), possibly correlative with the Second, Third, and Fourth Glacial Stages in the Himalayas to the west.

[89] Compare Hanson-Lowe, 1936.

[90] Huang and Hsu, 1936.

[91] von Wissmann, 1938*a*: 208; 1938*c*: 4; Lee, 1939: 205.

[92] Ma, 1940: 345; Ogura, 1934; Otuka, 1934.

[93] Teilhard, 1937*a*; 1937*b*; 1938*a*; Pei, 1939*a*; 1939*b*.

[94] Andersson, 1923: 118–121; Barbour, 1931; 1933*a*; 1933*b*; Barbour, Licent, and Teilhard, 1927; Bien, 1934; Teilhard and Piveteau, 1930; Teilhard and Young, 1933: 218–223; Teilhard, 1941: 11–17; Willis and Blackwelder, 1907: 256–261.

[95] Black, Teilhard, *et al.*, 1933: 27; Hopwood, 1935*b*; Pei, 1939*a*; Teilhard, 1941: 13–16.

Stage) separating the Lower Sanmenian (Nihowan —Taiku) Beds from the Upper Sanmenian red loams.[96] The latter, clearly of post-Villafranchian age on the basis of stratigraphy and fauna, have been placed at the base of the Middle Pleistocene in Northern China, as shown on the table (see p. 347). Now the vertebrate mammal remains from the Lower Sanmenian Beds represent a typically *Palaeartic* assemblage,[97] and there is other evidence to indicate that the climate was very much cooler at this time than it had been during the Pliocene. For in the lower portion of the Lower Sanmenian freshwater deposits, loessic loams associated with beds containing gypsum and marl, as well as clay deposits which yield abundant remains of a fossil flora, have been recorded.[98] The characteristics of the fossil plant remains demonstrate that they grew during a time of cool, semi-arid conditions when there was a comparatively short growing season.[99] This interpretation is supported by the presence of a high percentage of loessic loam and by the immediately overlying gypsiferous and marly beds. Furthermore, directly underlying these beds there is a boulder conglomerate, which has been recorded at several localities.[100] This evidence is strongly suggestive of a period of glaciation at the beginning of the Pleistocene in the high mountain regions of the Far East, probably corresponding with the First Glacial Stage in the Himalayan sequence,[101] when the Upper Siwalik Tatrot deposits, which likewise overlie a basal conglomerate, were accumulated (see p. 339). Accordingly, it is very probable that the upper portion of the Lower Sanmenian Beds (violet-colored freshwater sands and silts), which lithologically correspond very closely with the Pinjor Zone of Northwestern India, were formed during First Interglacial times, as shown on the table (see p. 347). But there is no proof as yet that Man was present in China at this time.[102]

[96] Teilhard and Pei, 1934: 387; Teilhard, 1941: 11, footnote 2; Hanson-Lowe, 1937: 257.

[97] Compare Teilhard, 1941: 16.

[98] Barbour, 1931: 78–79 and 87; 1933; Chaney, 1935*c*; Teilhard and Young, 1933: 213–216; also de Terra, 1941: 8; Movius, 1944: 60.

[99] Chaney, in Barbour, 1931: 78–79 and 104; Chaney, 1932 (especially pp. 139–142); Lee, 1939: 368.

[100] Barbour, 1931: 76; Teilhard and Young, 1930: 5.

[101] Such a correlation has in fact been proposed by Dr. Teilhard in his recent monograph (1941: 43 and fig. 22). Dr. Teilhard states: "I fully agree that the Villafranchian and Pleistocene glacial oscillations of Europe and North America are represented in the Chinese basins by pluvial periods, and therefore by definite maxima in the sedimentation." Thus for Dr. Teilhard the glacial cycle begins in the Villafranchian, although he insists on retaining this latter subdivision of the Late Cenozoic in the Late Pliocene. This matter resolves itself to a question of definition; the present writer considers that the Pleistocene begins with the onset of the First Glacial Stage, which in Northwestern India (Tatrot Zone, see p. 339) and Northern China (early Lower Sanmenian) coincides with the appearance of the so-called Villafranchian fauna.

[102] Professor Breuil (1935: 746) has illustrated a fragment of aplite from the Nihowan deposits in the Sangkanho Valley, which he considers to be the earliest tool thus far discovered in China. According to Dr. Teilhard (1935: 736; 1941: 55; also Pei, 1937*a*: 222; 1939*a*: 8), however, the so-called Nihowan specimen is not a human artifact, nor have the associated broken bones been utilized in the manner that Breuil has claimed.

STAGE OF CHOUKOUTIEN SEDIMENTATION

In Northern China, as in Upper Burma and Northwestern India (see pp. 335 and 340), a very marked phase of continental uplift separates the Lower Pleistocene (Villafranchian) from the Middle Pleistocene;[103] it is known as the Huangshui Erosion Stage (see fig. 6). This event led to the establishment of the modern drainage system in the Huangho Valley, and it brought about an abrupt change in the sedimentation —from dominantly lacustrine deposition to red slope-wash clays and thick red loamy fans, at the base of which is a basal boulder bed. The fauna from this latter horizon, including the Upper Sanmenian Beds, indicates that it is probably the counterpart of the Boulder Conglomerate (Second Glacial Stage) of Northwestern India and the Lateritic Gravels (Second Pluvial Stage) of Upper Burma.[104] Since it led to the widespread development of fissure deposits of the Choukoutien type, it is known as the Stage of Choukoutien Sedimentation. These reddish deposits (*terra rossa*) contain a typically Middle Pleistocene fauna,[105] in direct association with which abundant remains of *Sinanthropus pekinensis* and Lower Palaeolithic implements have been discovered at the famous site of Choukoutien: Locality 1, near Peking. Although it is claimed that the Chingshui Erosion Stage, an event which led to a slight rejuvenation of the topography, marks the close of the Middle Pleistocene,[106] the palaeontological evidence from Localities 3 and 15 at Choukoutien (see p. 389) is not in accord with this view. Since the fauna from these sites, both older than the Chingshui Erosion Stage and at the same time later

[103] Teilhard, 1937*a*; 1937*b*; 1937*c*; 1938*a*; 1941: 17–18; Pei, 1939*a*; 1939*b*; Young and Bien, 1937: 239–240.

[104] Compare Teilhard, 1941: 19.

[105] Summarized by Teilhard, 1941: 20–27. In this connection, it is interesting to note that by Middle Pleistocene times China was already divided into two very distinct palaeo-geographic zones, as Dr. Teilhard (*loc. cit.*: 27) has pointed out. These may be summarized as follows:

North Tsinling Zone—In the region of the North China Plain concretionary fans and slope-wash deposits consisting dominantly of red clays and loams (*terra rossa*) comprise the prevailing Middle Pleistocene soil facies. The fauna of this zone is characterized by groups with definitely northern affinities, such as Sika and Euryceroid Deer.

South Tsinling Zone—In the Red Basin of Szechwan and in the Yangtze Region the dominant Middle Pleistocene climate was apparently warmer and moister than in the north. As far north as 30° N. Lat. tropical soil formation (laterite) was under way. Of the palaeontological assemblage typical of this southern zone, known as the *Stegodon*-Orang-*Aeluropus* fauna, only the Water Buffalo (*Bubalus*) and *Sinanthropus*, both of which forms appear to have definite Sino-Malayan affinities, reached the north. (Compare Black, 1934: 114; Teilhard, 1937*b*, map 9; 1937*d*: 33; 1941: 25; Young, 1936: 515.)

[106] Compare Pei, 1939*b*: 122.

PERIOD			NORTH-WEST INDIA				UPPER BURMA			
			KASHMIR	NORTHERN PUNJAB			IRRAWADDY VALLEY			
			HIMALAYAN GLACIAL SEQUENCE	DEPOSITS	CLIMATE	ARCHAEOLOGY	DEPOSITS	CLIMATE		ARCHAEOLOGY
POST-PLEISTOCENE			ALLUVIUM : T_5	SILT TERRACE : T_5	Present Conditions Established	NEOLITHIC	SINGU SILT : T_5 MAGWE SAND	Present Conditions Established		NEOLITHIC
PLEISTOCENE	UPPER		4TH GLACIAL : T_4 (Deposition)	REDEPOSITED POTWAR : T_4	PLUVIAL	EVOLVED SOAN	Red Gravel & Sand : T_4 PAGAN SILT	PLUVIAL	Phase 2	LATE ANYATHIAN CULTURE
			3RD INTERGLACIAL : T_3 EROSION	MAIN TERRACE : T_3 EROSION	INTERPLUVIAL		MAIN TERRACE : T_3 EROSION	INTERPLUVIAL	Phase 1	
			3RD GLACIAL : T_2 (Deposition)	POTWAR LOESSIC SILT AND BASAL GRAVEL : T_2	PLUVIAL	LATE ACHEULEAN; LATE SOAN-B; LATE SOAN-A	NYAUNGU RED EARTH : T_2 (Deposition)	PLUVIAL Heavy Rainfall	Phase 3	EARLY ANYATHIAN CHOPPING-TOOL CULTURE
	MIDDLE		2ND INTERGLACIAL HIGH TERRACE : T_1 Prolonged Erosion. Upper Karewa Beds	HIGH TERRACE : T_1 Long Erosion Interval	INTERPLUVIAL Long dry period	ABBEVILLEO-ACHEULEAN (HAND-AXES); EARLY SOAN (CHOPPERS & CHOPPING-TOOLS)	HIGH TERRACE : T_1 Long Erosion Interval	INTERPLUVIAL Long dry period	Phase 2	
		UPPER SIWALIKS	2ND GLACIAL Karewa Gravel	BOULDER CONGLOMERATE	PLUVIAL Torrential rainfall Cool and temperate	PUNJAB FLAKE INDUSTRY ("PRE-SOAN")	LATERITIC GRAVEL and Uru Boulder Conglomerate	PLUVIAL Heavy Rainfall	Phase 1	
	LOWER (VILLAFRANCHIAN)		1ST INTERGLACIAL Lower Karewa Beds	PINJOR ZONE	INTERPLUVIAL Warm and temperate		UPPER IRRAWADDIAN BEDS	INTERPLUVIAL ? ..... PLUVIAL ?		
			1ST GLACIAL Conglomerate	TATROT ZONE	PLUVIAL Cool and temperate					
UPPER PLIOCENE				MIDDLE SIWALIKS DHOK PATHAN ZONE	SUB-TROPICAL		LOWER IRRAWADDIAN BEDS			

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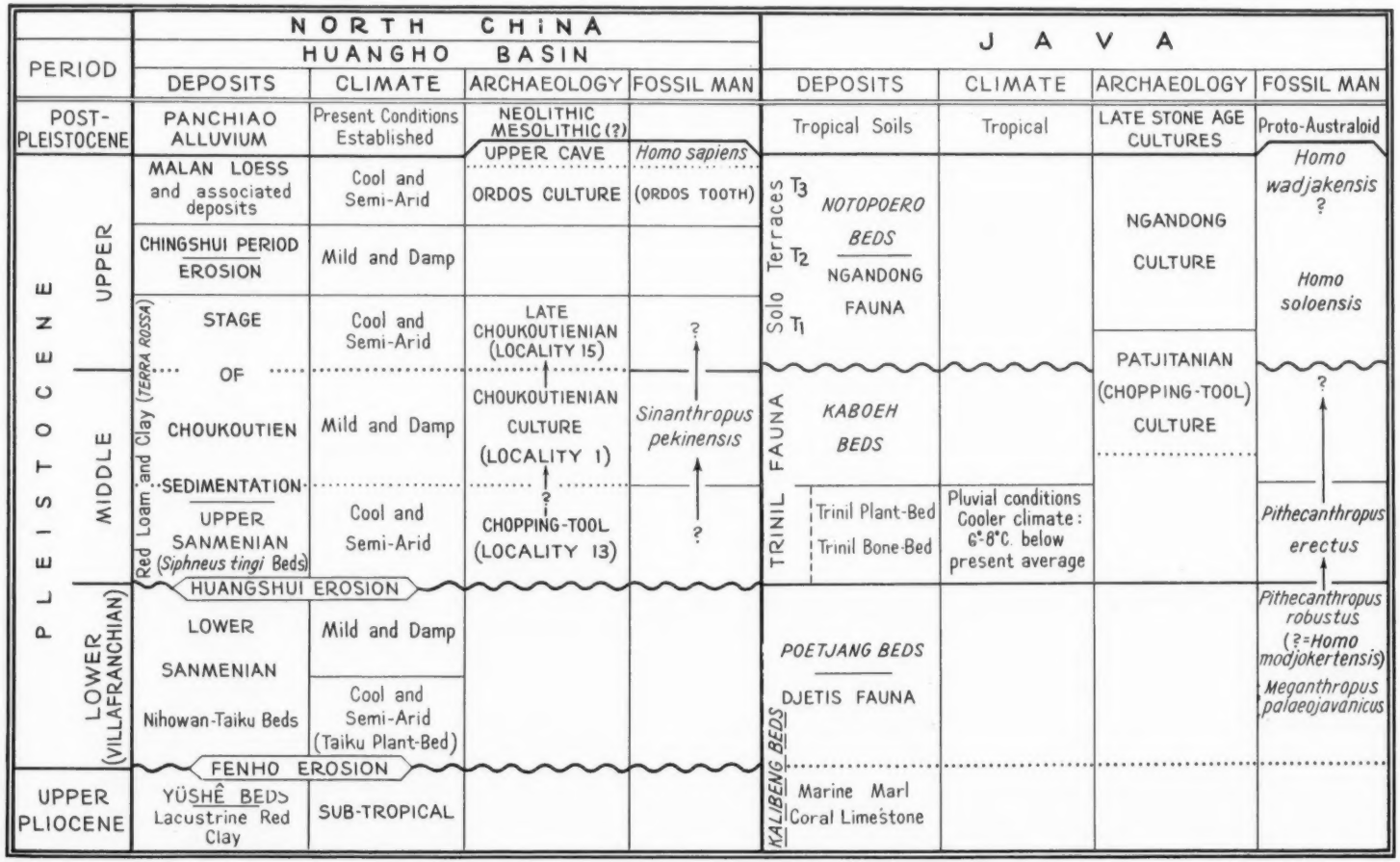


TABLE 1. Tentative Correlations: Pleistocene Stratigraphy, Palaeolithic Cultures, and Early Man in Southern and Eastern Asia. (After Movius, 1944.)

than the true Middle Pleistocene group, has close affinities with the Upper Pleistocene assemblage,[107] it has been concluded that the deposition of the typical Choukoutien red clays and loams did not come to an end until early Upper Pleistocene times, as shown on the table (see p. 346).[108] Furthermore, as stated on page 398, there is strong evidence supporting the view that the sediments filling Locality 15 at Choukoutien were laid down during the cool, dry conditions of a continental glacial period.

The climatic significance of the Choukoutien red clays and loams, including the basal conglomerate, is interesting when interpreted in the light of the Himalayan glacial cycle. At many localities this deposit contains a high percentage of loessic loam, true loess and even typical "loess-kindeln,"[109] which could only have accumulated in a semi-arid climate. On the other hand, the reddish color of these sediments indicates chemical alteration under relatively warm and moist (semi-tropical) conditions. This evidence can only mean that the clays and loams of the Choukoutien Stage were laid down during more than one climatic period, a fact which is likewise reflected by the fauna.[110] It is therefore suggested that, on the basis of the sequences established in Northwestern India and Upper Burma, this Chinese horizon very probably covers the Second Glacial (or Pluvial), the Second Interglacial (or Interpluvial), and the Third Glacial (or Pluvial) Stages, a series of events assigned to the Middle Pleistocene and the first part of the Upper Pleistocene (see table 1). Until further work is done on this problem, with particular emphasis on soil profile studies,[111] however, the above correlation should be regarded as tentative. In the meantime, it fits reasonably well with the existing data, providing one is safe in assuming that the Malan Loess and associated deposits are of Fourth Glacial age,[112] and that the Chingshui Erosion Stage belongs to the Third Interglacial Stage. It is probable that during this latter interval, the process of reddening of the loams and clays of the Choukoutien Stage—a process that began during Second Interglacial times—was completed, prior to the deposition of the Malan Loess.

MALAN LOESS AND ASSOCIATED DEPOSITS

In Northern Shensi and Eastern Kansu the Malan Loess is up to 50 meters thick,[113] and it has been proved that it is a true loess.[114] This formation of dominantly yellow to buff-colored deposits rests more or less conformably on the eroded surface of the red loams and clays of the Choukoutien Stage of Sedimentation (see fig. 6). The basal layers consist of fluvial sands and gravels, and the entire complex yields throughout a typically Upper Pleistocene fauna.[115] It seems apparent that the Malan Loess was accumulated during the relatively much colder and drier continental climate of the Fourth Glacial Stage.[116]

Archaeologically the Malan deposits are of great importance, for at Sjara-osso-gol, Shuitungkou, and elsewhere in the Ordos region (including Northern Kansu and Shensi), Middle-Upper Palaeolithic occupation sites were discovered in the middle 1920's.[117] These belong to the Ordos culture. Later, in 1929, another series of sites of the same period was reported from the Huangho Valley between Shansi and Shensi.[118] The industry consists of blade implements, points, borers, scrapers, rudimentary burins, discs, worked pebbles—small to medium-sized choppers and chopping tools, etc., for the most part made of hard, grayish quartzite.[119] In the Ordos these were associated with hearths, as well as broken and charred animal bones, all found near the base of the loess. With the exception of one tooth (a permanent incisor of "shovel-shaped" type), no human remains were found.[120] With reference to these Ordos implements, Dr. Pei states "although a little better retouched, they are comparable with those collected from the *Sinanthropus* deposits" at the Middle Pleistocene site of Choukoutien.[121] Certainly this question of possible connections between the Choukoutien and Ordos cultures would well repay further investigation.

POST-PLEISTOCENE

As in Northwestern India and Upper Burma, there is one Post-Pleistocene stage clearly defined in Northern China.[122] This is known as the Panchiao Stage, a stage of general erosion caused by a very gradual rising of the land; this movement is still in progress. After a temporary moist phase during Neolithic times, Northern China has become increasingly more arid during the Recent Stage.

SUMMARY AND CONCLUSIONS

With the single exception of Java, where the situation is to a certain extent obscured owing to the emergence of that island from the sea, the evidence from

[107] Pei, 1939*a*; 1939*c*.

[108] Teilhard, 1937*a*: 218; 1937*b*: 211; Movius, 1944: 53.

[109] Barbour, 1931: 86; 1933*a*; 1935*b*; Teilhard and Young, 1933; von Wissmann, 1938*b*: 321.

[110] The typically Middle Pleistocene assemblage from Choukoutien: Locality 1 includes tundra forms (5), steppe forms (16), and animals of a temperate habitat (10), according to Professor Lee (1939: 369).

[111] Compare Thorp, 1935*b*.

[112] Compare von Wissmann, 1938*a*.

[113] Teilhard, 1941: 32.

[114] Barbour, 1926; 1930; Cressey, 1934: 186, fig. 85.

[115] Black, Teilhard, *et al.*, 1933: 28; Teilhard, 1941: 34; Teilhard and Pei, 1944: 7–20; Andersson, 1942.

[116] von Wissman, 1938*a*; see also p. 343.

[117] Teilhard, 1924; Teilhard and Licent, 1924*a*; 1924*b*; Licent and Teilhard, 1925; Boule, Breuil, Licent, and Teilhard, 1928.

[118] Teilhard and Young, 1930: 32–35.

[119] Compare Teilhard, 1941: 66–77.

[120] Licent, Teilhard, and Black, 1926.

[121] Pei, 1937*a*: 228; also Pei, 1939*a*: 9.

[122] Teilhard, 1937*b*: 199–200; 1941: 38–39.

each of the regions discussed above is consistent in demonstrating where the boundary between the Pliocene and the Pleistocene should be placed in terms of the Late Cenozoic sequence as a whole (see table on pp. 346–347). This horizon, fundamental to the establishment of an accurate time-scale for dating Early Man and Palaeolithic cultures, is fixed in Northwestern India, Upper Burma,[123] and Northern China by:

(*a*) A distinct unconformity resulting from epirogenic movements in the Central Asiatic massif, which initiated a cycle of erosion.

(*b*) A deterioration in the climate, already heralded by the increasingly arid, but still sub-tropical, conditions of Upper Pliocene times, which replaced the tropical and equable environment of the Lower Pliocene (Pontian), and which culminated in the onset of the first stage of continental glaciation. This latter event is manifest in the regions bordering on the highlands by a period of greater rainfall, and in the more northerly areas by a phase of cool, dry, continental conditions.

(*c*) The comparatively sudden appearance of the so-called Villafranchian fauna—true *Equus*, *Elephas*, and *Bos*. (*Equus*, essentially a gracile plains animal, was not introduced until the Recent Stage in Java.) This assemblage is augmented by the introduction of the Camel into Northern China and Northwestern India.

Considering the Pleistocene sequences of the several regions under consideration as a climatological, geological, and palaeontological whole, the extremely coherent and uniform pattern which each reveals is indeed extraordinary. Notwithstanding certain regional differences in Northern China and Java, it is felt that the present data are sufficiently reliable and complete to justify the correlations mentioned in the text and shown on the table (see pp. 346–347). On this basis, the Late Cenozoic stratigraphy of Southern and Eastern Asia rests on a fairly solid foundation of fact. Those gaps which exist will doubtless be narrowed down in the future, and the weak links strengthened as the result of further work; a correspondingly more refined time-scale will thereby be established. Before any broad-scale correlations are attempted, however, between Asia and Europe on the one hand and Asia and Africa on the other,[124] it is considered a vital necessity that sequences, comparable with those summarized above, be established for some section of Central Asia, as well as for the Near East, including the Caucasus. In any case, it is obvious that a natural system of chronology (i.e., one based on the Natural Sciences) is a prerequisite to a rational interpretation of prehistoric cultural developments in the same or contiguous areas. Furthermore, palaeo-anthropologists necessarily must be able to date the fossilized remains of Early Man before attempting to present their conception of a reconstruction of the human "evolutionary tree."[125] Since Man, considered both organically and as a social being, at any given point on the time-scale is an extremely variable factor (except within very broad limits), and since the Natural Sciences deal with phenomena that are more nearly constant, it is only by objectively synthesizing and utilizing the results achieved through this latter approach that one is justified in drawing conclusions that can be considered in any sense either scientific or valid. Throughout, the archaeological problems must always be considered from a cultural standpoint (i.e., from point of view of the Social Sciences), and therefore the concept of using artifacts as "index fossils" for dating purposes must be employed with great caution, especially when dealing with Palaeolithic problems.

Whereas the natural scientist makes direct use of assemblages of fossil material for dating geologic horizons, the only fossils available to the archaeologist are tools, which Professor V. G. Childe has recently defined as "those extra-corporeal organs by the improvement of which human societies have progressively enlarged their capacities for survival."[126] In the final analysis, therefore, prehistoric archaeology must be regarded as one of the Humanities, although it will always lean heavily on the Natural Sciences, not only to provide a reliable time-scale, but also to furnish the necessary data for reconstructing the environmental conditions obtaining at the time that a given prehistoric culture flourished.

III. TERMINOLOGY

The terminology used throughout this paper to describe the archaeological material from Eastern Asia and Northwestern India is based entirely on the form and technique of manufacture of the tools themselves. These, rather than any hypothetical functions, are considered to be primary criteria. Since a large majority of the archaeological specimens from the regions under consideration consist of core implements that have presumably been used for chopping, cutting, and scraping, it is obviously imperative at the outset to group them into convenient categories for purposes of description.

In considering the new Palaeolithic material from Upper Burma, Northwestern India, Northern China, Java, and Malaya, it was found necessary to establish three new classes of implements—*chopping-tools*, *hand-adzes*, and *proto-hand-axes*—and to redefine the terms

[123] Although the Irrawaddian Beds in Upper Burma may be subdivided into an Upper Zone (Villafranchian) and a Lower Zone (Pliocene) the actual boundary has not yet been established in the field (see p. 335). Therefore, the statements included under (*a*) and (*b*) cannot definitely be applied to that region at present.

[124] Compare Paterson, 1940; 1941.

[125] See Le Gros Clark, 1946*b*: 83.

[126] Childe, 1944: 1.

chopper and scraper.[1] Admittedly each group is a purely artificial category of little or no significance from point of view of function, which, with respect to such a remote period as the Middle Pleistocene, is most emphatically a matter of speculation. In the sense adopted here, therefore, such a term as *hand-adze*, for example, refers specifically to a tool of a certain shape, and flaked in a definite manner, rather than to an implement intended solely for cutting. Indeed it is very probable that these tools were used for scraping or even chopping as well. On this basis, the following definitions are advocated, the terms being adapted for purposes of describing primitive Lower Palaeolithic cultures of the Early Anyathian (Burma), Soan (Northwest India), Choukoutienian (North China), and Patjitanian (Java) type:

(*a*) *Chopping-Tools* (fig. 7, no 3)—These are core implements usually made on pebbles, or rough, more or less tabular, chunks of silicified or similar types of rock. They are bifacial artifacts in the sense that the cutting-edge has been worked from both sides. In most cases, the edge thus produced is markedly sinuous, since it is normally worked by alternate flaking, or rather by the intersection of alternating flake scars. In other words, it is in the form of a broad W in the majority of instances.

(*b*) *Hand-Adzes* (fig. 7, no. 2)—The secondary working along the edge is restricted to the upper surface of one end of these roughly tabular chopping or cutting implements. Preparation of this type produces the characteristic single-beveled, adze-type of cutting edge, in contrast to the double-beveled, or bifacial (V-sectioned), axe-type of cutting edge. Hand-adzes are usually made on cores, and the cutting edge, which may be straight, slightly rounded, or even pointed, forms a right angle with the long axis of the tool. In a sense, hand-adzes may be regarded as a special class of chopper—of square or rectangular, rather than of round or oval form.

(*c*) *Proto-Hand-Axes* (fig. 7, no. 4)—Crude and roughly pointed or oval types of hand-adzes of plano-convex section are included in this category. These implements are worked on the upper surface *only*, and in many cases they are made on flakes. Seldom is the upper surface flaked all over, and the butt-end normally exhibits large areas of cortex. From a typological point of view, these tools appear to be transitional between hand-adzes and true bifacial hand-axes, or *coup-de-poings*.

(*d*) *Choppers* and/or *Scrapers*—The only essential difference between a chopper (fig. 7, no. 1) and a scraper, both flaked by secondary (often resolved) working on the upper surface along one side only, is one of gross size. In this sense "large, crude scrapers" and "massive scrapers" are called *choppers*. This type of unifacial tool normally has a round, semi-oval, or almost straight cutting edge, formed by the removal of flakes from the *upper surface* of the implement *only*. The cutting edge itself may be either along the side or across the end of the specimen. In certain instances, however, limited flaking is present on the lower surface, but in most cases this appears to be the result of use. Although many of the implements in this category are core tools made either on pebbles or angular chunks of rock, examples manufactured from large flakes are also quite common.

A scraper (normally these are of the "side" variety) is considered to be a small chopper. Scrapers are usually made on flakes, but since the only really satisfactory criterion is size, it will be recognized that at present no hard and fast rule can be made to differentiate between these two classes of implements.

In general, no absolutely rigid line can be drawn between the above classes of implements in all cases. Although one can easily segregate the "type specimens" within the total range of any given large series, some of the examples which fall at either the upper or at the lower limit of the various categories, according to the definitions given above, inevitably merge imperceptibly with objects grouped in another class of implement. Chopping-tools with alternately flaked edges, of course, comprise a definite type, concerning which classificatory difficulties seldom arise. But the degree of merging, or overlap, in the case of scrapers → choppers → hand-adzes → proto-hand-axes may be considerable in many instances. Indeed, for this reason, it must be frankly admitted that the probability of any two individuals agreeing on what groups certain of the objects "fall into" is extremely remote. The essential points to stress, however, are (*a*) since the classification adopted in this paper is the work of the writer and *not* of the people who made the tools, the system used here has been established solely for purposes of facilitating the description of the implements themselves, and (*b*) regardless of terminology and/or classificatory procedure, choppers, chopping-tools, hand-adzes, and proto-hand-axes all differ fundamentally from hand-axes, which are true bifacial implements flaked all, or almost entirely, over both surfaces. In other words, as suggested on page 408, the two represent basically different culture traditions. It is maintained, therefore, that on this basis one is justified in recognizing two mutually distinct culture traditions in the Lower Palaeolithic of the Old World: one, the chopper—chopping-tool tradition, which is fundamentally "Eastern" in its distribution, and the other, the hand-axe tradition, which is fundamentally "Western."

[1] Compare Movius, 1943: 350–351; 1944: 10–11, 41 and 91; also Braidwood, 1947: 38 and fig. 1.

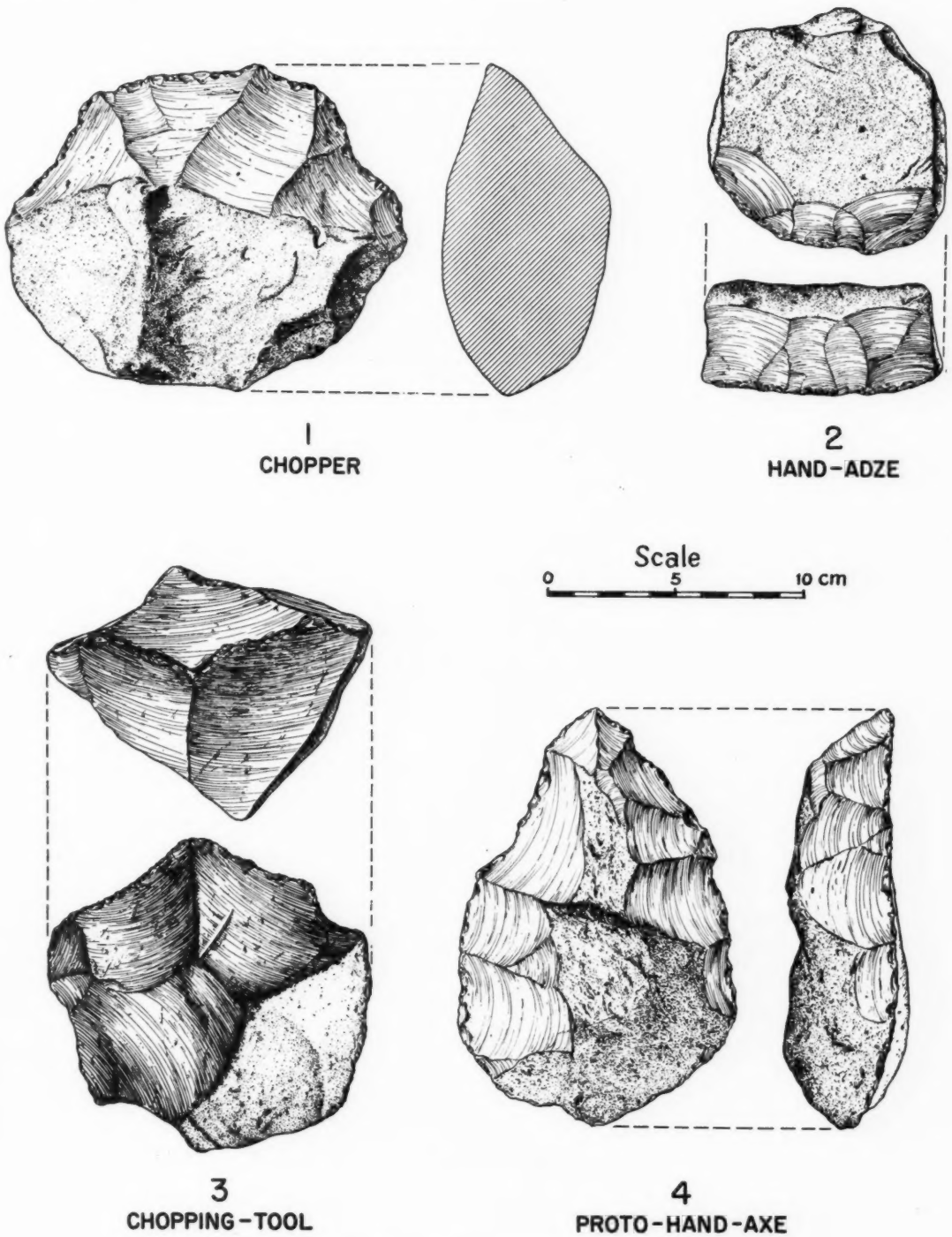


FIG. 7. Types of Lower Palaeolithic implements from Southern and Eastern Asia.

IV. THE LOWER PALAEOLITHIC OF JAVA

In October, 1935, Dr. G. H. R. von Koenigswald of the Geological Survey of the Netherlands East Indies and Mr. M. W. F. Tweedie of the Raffles Museum, Singapore, discovered an extremely important Lower Palaeolithic site in South-Central Java.[1] This is situated in the valley of a small stream—the Kali Baksoka (see fig. 8, no. 1)—which flows southwestward through the Zuider Mountains and debouches into the sea west of Patjitan on the south coast of the island. This important locality lies near the village of Poenoeng. Composed of an uplifted and tilted block of Upper Miocene limestone which dips northward, the Zuider Mountains comprise a series of typical karstified hills. This limestone in turn rests on an older volcanic formation, which includes shales and tuffaceous beds, and it contains layers of silicified tuff, as well as some fossilized wood. In the base of the valley, where the volcanic series is exposed, large pebbles and boulders of silicified material, eroded out by the stream, occur.

GEOLOGY OF THE PATJITAN SITE

The karst region of the Zuider Mountains is covered by red earth, or *terra rossa*, which is represented as Deposit 2 in the section, shown in figure 9. This red earth everywhere fills the depressions as well as the fissures that have been developed in the karstified limestone.[2] At a place called Tabouhan, not far from Poenoeng, one of these fissures was investigated by Dr. von Koenigswald, and it was found to contain *Stegodon* sp., *Elephas namadicus*, a small Pig typical of the Trinil Beds of Central Java, Tapir, Malayan Bear, Deer, and *Echinosorex*, in addition to teeth of *Simia*, *Symphalangus*, and *Hylobates*.[3] According to von Koenigswald, this fauna appears to belong to a normal Trinil (Middle Pleistocene) assemblage.[4] It is not only the same age, but also very similar to the fissure faunas of the Northern Shan States of Burma,[5] as well as the Yangtze Valley and other sections of South China,[6] where it is likewise found in a karstified limestone context. This evidence strongly suggests that the karst topography of the Zuider Mountains of Southern Java was developed by Middle Pleistocene times.

In the vicinity of Poenoeng, the red earth is overlain by a mantle of volcanic ash—Deposit 3 in the section (fig. 9). This horizon has to date yielded no fossils, but, according to Dr. R. W. van Bemmelen of the Geological Survey of the Netherlands East Indies, who has made an intensive study of these ash deposits, it belongs to the younger Mt. Lawoe eruptive series. Now on the Central Plains of Java this is contemporaneous with the Upper Pleistocene *Notopoero* Beds, which, as shown elsewhere,[7] are clearly separated from the Middle Pleistocene *Kaboeh* Beds by a marked unconformity. This latter stratigraphic feature is absent, however, in the Zuider karst region, which adds to the difficulties of dating the Palaeolithic material.

An overwhelming majority of the implements themselves have been manufactured of silicified tuff, although some are of silicified limestone, and in a few cases fossil wood has been used. All are heavily patinated and water-worn to varying degrees, especially those found in the modern gravel spread of the Baksoka River (fig. 8, no. 2).

As Dr. Teilhard de Chardin has pointed out, there are three terraces in the valley, which are shown in the section.[8] The lowest of these terraces (T_3) is composed mainly of silt; it is found 5 to 6 feet above the level of the stream. The second terrace (T_2) occurs higher up, at an elevation of approximately 30 feet, and its constituents are red gravel and loam with a basal layer of coarse gravel, referred to as "boulder conglomerate" by Dr. von Koenigswald.[9] Several rolled and obviously derived Lower Palaeolithic implements, in addition to a premolar of *Bos* sp., have been found in this basal layer. T_1, the highest terrace in the series, is 50 to 60 feet above the Kali Baksoka, and it is composed of dissected remnants of boulder gravel overlain by red loam. Implements have never been found in this terrace, but to date no intensive search has ever been made. Therefore, these terrace deposits are of little help in trying to establish the age of the Lower Palaeolithic of the Patjitan site. Nor can the question be definitely settled until an intensive physiographical survey of the region is undertaken. In the meantime, the evidence summarized below indicates that the age of the archaeological material in question[10] is very probably late Middle Pleistocene, or at the latest early Upper Pleistocene:

(*a*) The raw material from which most of the implements have been manufactured is clearly derived from the older volcanic series, and, therefore, it was only available *after* the stream had cut down and exposed these beds, subsequent to the formation of the karst. It was during this stage that the Trinil fauna occupied the region, according to Dr. de Terra.[11] On the basis of the evidence obtained to date, it appears very unlikely that the Lower Miocene volcanics were exposed before the latter part of the Middle

[1] von Koenigswald, 1936*c*; 1936*d*; see also Clark, 1936.
[2] Compare de Terra, 1943: 457.
[3] von Koenigswald, 1937*a*: 27; 1939*a*: 37.
[4] Compare von Koenigswald, 1940: 55–67.
[5] de Terra, 1938*a*: 410; Colbert, 1943: 417–421 and 424–425.
[6] Matthew and Granger, 1923; Colbert, 1942: 1454; Pei, 1935*b*; 1940*b*; Bien and Chia, 1938; Young, 1939; Young and Mi, 1941: 102–104.
[7] de Terra, 1943: 446; Movius, 1944: 86.
[8] Teilhard, 1937*d*: 30; 1938*c*: 455.
[9] von Koenigswald, 1936*c*: 52–53.
[10] In Neolithic times this locality was the site of an extensive axe factory.
[11] de Terra, 1943: 459.

1

2

3

FIG. 8. The Baksoka Valley, north of Patjitan in Southern Java. (1) General view of the Baksoka Valley East of Poenoeng, South-Central Java, showing the Karst Topography. (2) Gravel-strewn surface in the bed of the Baksoka River, near Poenoeng, where Lower Palaeolithic implements occur in profusion. (3) Bed of a small stream, a tributary of the Kali Baksoka, where Lower Palaeolithic implements have been collected. This stream-bed is cut into Volcanic Ash, indicated as Deposit 3 on the section (fig. 9).

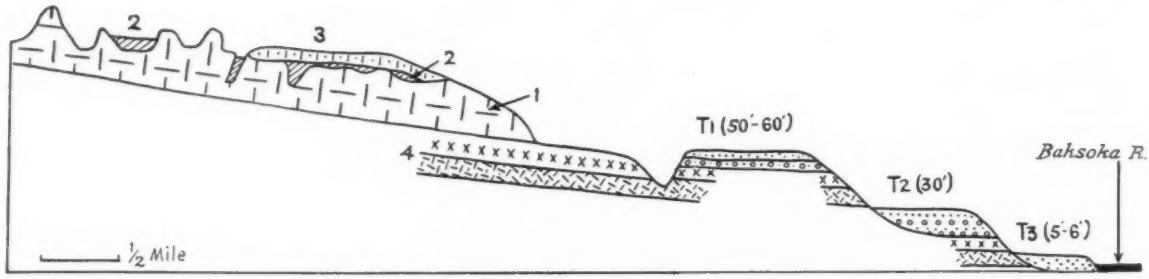


FIG. 9. Generalized section of the Baksoka Valley, near Poenoeng (Zuider Mountains). (After de Terra, 1943, and Teilhard, 1937*b*.) (1) Miocene limestone—karstified. (2) Red earth (*terra rossa*). (3) Volcanic ash. (4) Older Volcanics with silicified tuff and fossil wood T_1; T_2; T_3—Terraces.

Pleistocene, which fixes a maximum age for the archaeological material.

(*b*) As previously stated, nearly all the implements of the Lower Palaeolithic series found on the gravel-strewn floor of the valley (fig. 8, no. 2) are heavily rolled. The writer observed, however, that those collected on the valley slopes, near the headwaters of the tributary streams (e.g., fig. 8, no. 3), and on the plateau east of Poenoeng—the source of the Kali Baksoka—are comparatively fresh. Typologically there is no discernable difference between the rolled and the unrolled specimens, and both are heavily patinated. This fact strongly suggests that the region was occupied by Palaeolithic Man prior to the last tectonic movement in the Zuider Mountains, which inaugurated a new cycle of erosion. This occurred at the end of Trinil times, suggesting that the Baksoka terraces were formed during Upper Pleistocene times. Since a few derived implements have actually been found in T_2, they probably belong to an older stage—late Middle Pleistocene or early Upper Pleistocene. Indeed, it is quite possible that some of them at least have been eroded out of an ancient cave or fissure deposit, such as the one at Tabouhan (see above), which may have served as a Palaeolithic occupation site during the later portion of the Middle Pleistocene.

(*c*) From a typological point of view, the pronouncedly Lower Palaeolithic aspect of the archaeological material from the Patjitan site does not even remotely suggest a cultural relationship with the Upper Palaeolithic material found in the terraces of the Solo River and at Sangiran, near Soerakarta.[12] The latter is demonstrably of Upper Pleistocene age and is without question the culture of Solo Man (*Homo soloensis*). To date no complete account of this culture, which is represented by implements of stone, bone, and antler, has appeared, although it has been briefly mentioned by several authors.[13] The bone implements include a bilaterally barbed spear-head, or (?) harpoon, two points made from Sting Ray tails, a bone knife with the edge polished, and a perforated foot bone, possibly of Water Buffalo. Of antler (identified as *Axis lydekkeri*, a Pleistocene Deer) there are two picks made by sharpening the brow tine and using the main branch as a handle. The stone artifacts, most of which are rather crude and small (less than 7 centimeters long), are mostly flakes and blades, although a few cores occur as well. They are all made of chalcedony and have plain striking platforms. Very few of them are well struck, and, in general, the flaking technique is crude and degenerate in comparison with that of the classic Upper Palaeolithic cultures of Europe and the Middle East. The main tool types include knives, scrapers, points, steep scrapers (rare), and borers made on the end of short chunky blades. The term "Ngandong Culture" is proposed for this assemblage, although admittedly further investigations at the sites in question

[12] de Terra, 1943: 446 and 454; Movius, 1944: 90, footnote 58. In this connection, it should be pointed out that the so-called "Clacton" flake industry from Sangiran, found by von Koenigswald (1937*a*: 29; 1939*a*: 42), actually comes from the Notopoero Beds and *not* the Trinil (*Pithecanthropus erectus*) horizon, as originally maintained (de Terra, 1943: 446, 456–457; Movius, 1944: 90). To date no archaeological material has been found in Java in direct association with the well-known Trinil fauna (Middle Pleistocene), in spite of the claims of several authors (compare van der Hoop, 1938: 22 and 25; 1941: 5, fig. 2, A–E; Zeuner, 1946, chart on p. 277). Indeed, as van Stein Callenfels (1936*c*) has pointed out, typologically the Sangiran flakes are "practically identical with those from the Late Pleistocene of the Solo Valley."

[13] Compare van Stein Callenfels, 1934*a*; 1934*b*; 1936*a*; 1936*c*: fig. 1; 1938: 97 and pl. XXXIII (upper); Oppennoorth, 1936; von Koenigswald, 1937*a*; 1939*a*; van der Hoop, 1941: 4–5 and fig. 1; Heine-Geldern, 1945: 154. To the present writer Heine-Geldern's (1945: 154) comments concerning the alleged unsystematic nature of the excavations in the Solo Valley, in particular those at Ngandong, seem totally unwarranted, inasmuch as the work was undertaken by the Geological Survey of the Netherlands East Indies for the expressed purpose of obtaining palaeontological, rather than archaeological, material.

may reveal that not all the material collected to date is contemporary. However, since the present evidence is so scanty, one must assume that within rather broad limits it is all of the same age. In any case, the very fact that this culture is everywhere found in *Notopocro* (Upper Pleistocene) deposits associated with an Upper Pleistocene fauna argues in favor of a probable Middle Pleistocene dating for the Lower Palaeolithic material from Patjitan. In commenting on this point, the late Dr. van Stein Callenfels states that "the difference between these last implements (those from Patjitan) and the artifacts of the Solo River terraces is so great that it seems as if they were made by two quite different types of primitive *Homo*." [14]

The physiographical, palaeontological, and archaeological evidence summarized above unanimously implies a late Middle Pleistocene, or at the latest an early Upper Pleistocene, dating for the Lower Palaeolithic material from the Patjitan site. Furthermore, as will be presently demonstrated, the fact that culturally it belongs to the same chopper—chopping-tool complex as the Soan of Northwestern India, the Anyathian of Upper Burma, and the Choukoutienian of Northern China completely accords with this conclusion. On the basis of the suggested correlation between the Himalayan glacial cycle and the stages when new land mammals entered Java from the mainland of Southeastern Asia,[15] it seems very probable that the Lower Palaeolithic of Patjitan should be placed in the second half of the Second Interglacial and the beginning of the Third Glacial Stage (see table on p. 347). But until this material has been found either in direct geological association with definitely dated deposits, or in a fossiliferous fissure, it is impossible to be dogmatic concerning its age. In any case, there is absolutely no evidence at present to support Dr. Heine-Geldern's suggestion [16] that "we do not know whether the Patjitan tools belong all to a single culture, or to a series of subsequent cultures. . . ." On the contrary, the writer, after studying over 2,400 implements collected at this site by Dr. von Koenigswald, was tremendously impressed with the typological homogeneity which they revealed.

THE PATJITANIAN CULTURE

Many of the Lower Palaeolithic implements from Patjitan are large, massive, and crudely worked forms, very few of which exhibit a uniform retouch. Large portions of the original crust, or cortex, of the parent nodule from which the tools have been manufactured are present, especially at the butt-ends of the implements. The worked edges are frequently jagged or undulating, as the result of the removal of comparatively large secondary flakes. Coarse resolved flaking is typical in the case of the large- and medium-sized tools. The predominant patina is brown—and in all shades from light ochreous colors to deep, almost black examples. In addition, a dark gray patina is present on a few specimens, but this is rarely true of the silicified tuff implements. On the other hand, the silicified limestone displays all shades of gray; in fact a few examples are a dull chalky white. An interesting technique has been employed in obtaining the raw material, which exists in the form of huge boulders in the valley of the Kali Baksoka. Apparently prehistoric man broke these into convenient sizes for manufacture into implements by dropping other stones on them. The enormous flakes and flake fragments procured by this "shattering" process (e.g., fig. 15, no. 3) seldom display either a bulb of percussion or a striking platform. In some cases, particularly large flakes actually have been used as cores or nuclei from which smaller flakes and blade-like tools have been detached. For this reason, it is impossible to classify the Patjitanian in terms of the core or flake traditions recognized in other regions. In spite of the fact that the overwhelming majority of the implements from the Patjitan site are made on flakes, natural water-worn pebbles, as well as tabular pieces of stone, have been used in some instances. But, strictly speaking, only a very small proportion of the Patjitanian are true core tools. The relative frequency of the main categories of implements from Patjitan, represented in Dr. von Koenigswald's large collection from the site, may be tabulated as follows:

Type of Implement	Total	Percentage of Total
Choppers	431	17.82
Chopping-tools	89	3.68
Hand-adzes	87	3.59
Proto-hand-axes	195	8.06
Hand-axes	153	6.32
Flake implements	596	24.64
Trimming flakes showing signs of use	807	33.36
Cores	31	1.28
Miscellaneous	30	1.24
Totals	2419	99.99

CHOPPERS

Many choppers occur in the Patjitanian (fig. 10, nos. 1–4) which are identical with those of the Early Anyathian of Burma,[17] and they are by far the commonest type in the series of large implements from the Baksoka Valley. Massive forms, produced by single edge-trimming, as well as flake or core tools with crude chipping on both sides of the cutting edge, are typical. Some are concave or square-ended, but the great majority have slightly convex edges produced by resolved flaking, in most cases on the upper surface only. Me-

[14] van Stein Callenfels, 1936*d*: 210.
[15] Compare de Terra, 1943: 455; Movius, 1944: 87–88.
[16] Heine-Geldern, 1945: 155.
[17] Compare Movius, 1943: 362, figs. 63 and 64.

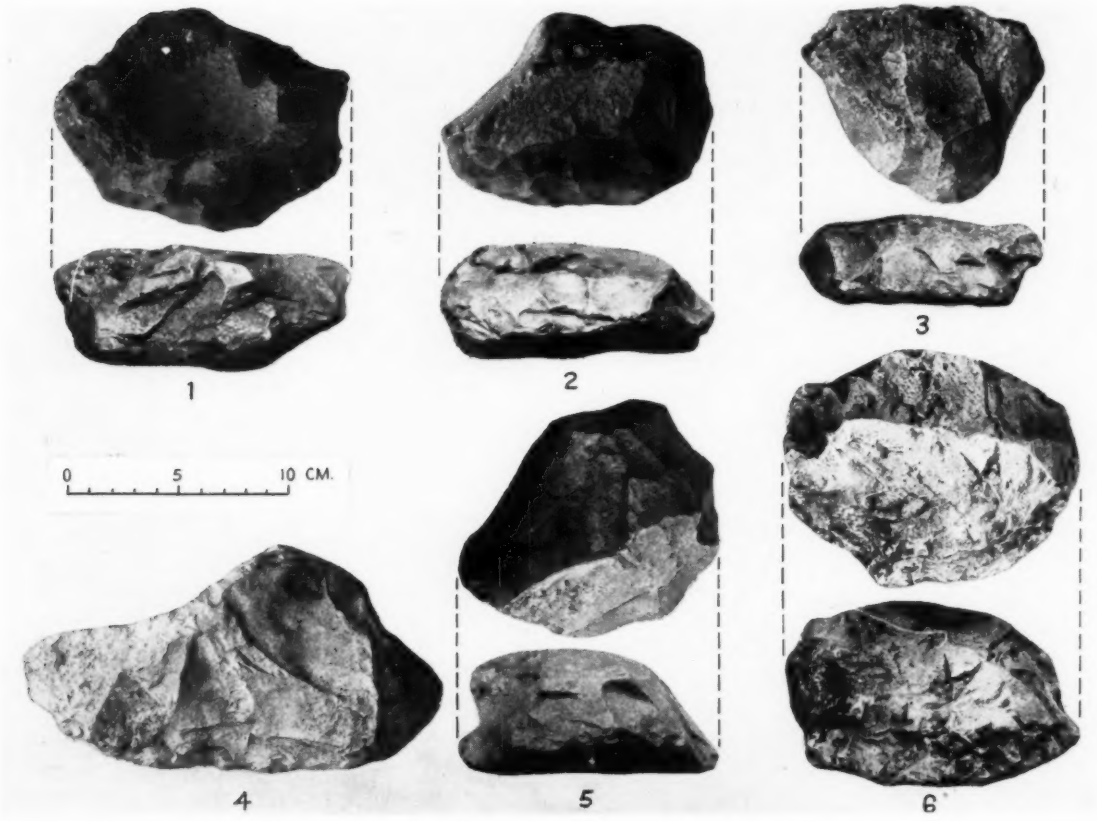


FIG. 10. Lower Palaeolithic (Patjitanian) implements from South-Central Java. (Courtesy of Dr. G. H. R. von Koenigswald.)

dium- and small-sized choppers may be considered as a class of crude side scraper, and it is very probable that they served both functions.

CHOPPING-TOOLS

The chopping-tools (fig. 11, nos. 1 and 4–6), which are core implements with an alternately flaked cutting edge, are indistinguishable from Early Anyathian forms. In fact a few specimens with the characteristic "overthrust" edge occur (fig. 11, no. 6). In the majority of cases the edge, described on p. 350, is battered and chipped as the result of use. Many of these implements are made on natural water-worn pebbles.

HAND-ADZES

This type of implement (fig. 10, nos. 5 and 6) is likewise very characteristic of the Early Anyathian of Upper Burma, and it may be described either as a specialized type of chopper or as a massive end scraper (see p. 350). These tools are flaked on the upper surface only, the cutting edge being sharper and more acute than it is on the choppers. Furthermore, in the case of implements in this category, the secondary working extends farther back from the edge. The lower surface of these implements is flat, since they have been usually made on thick massive flakes, produced by the shattering method described above. These implements, which may be considered generalized cutting tools, differ fundamentally from axes in that the latter are always bifacially sharpened on both sides of the cutting edge.

PROTO-HAND-AXES

From a typological point of view proto-hand-axes (fig. 11, nos. 2 and 3; fig. 14, no. 4), which are defined on page 350, are transitional between hand-adzes and true bifacial hand-axes. In a sense, they are crude and roughly oval or pointed hand-adzes worked on the upper surface only and in most cases made on flakes. They have a plano-convex section. Only in a few instances has the upper surface been flaked all over, and the butt-end normally exhibits large areas of cortex, although an occasional specimen reveals that some at-

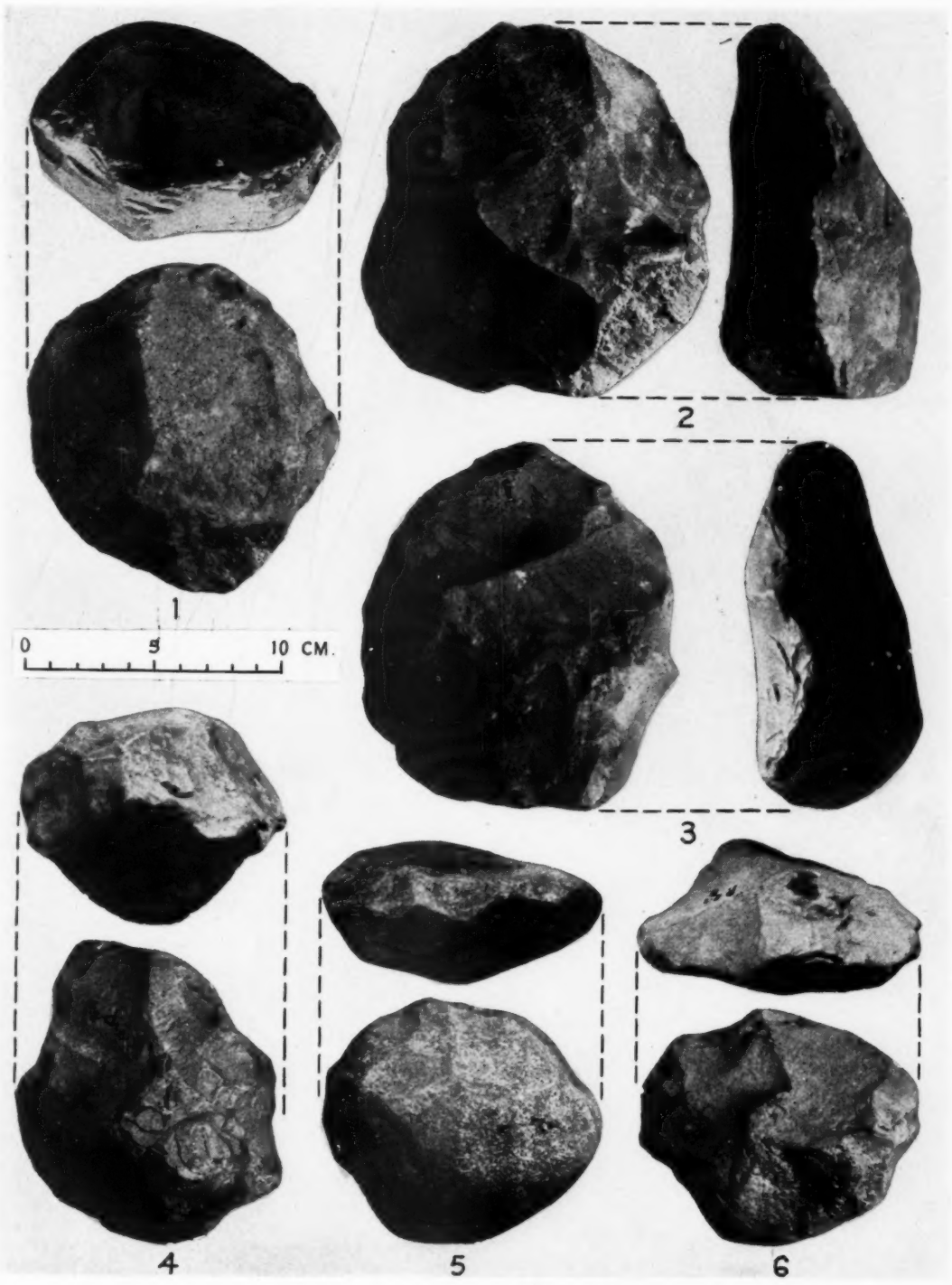


FIG. 11. Lower Palaeolithic (Patjitanian) implements from South-Central Java.
(Courtesy of Dr. G. H. R. von Koenigswald.)

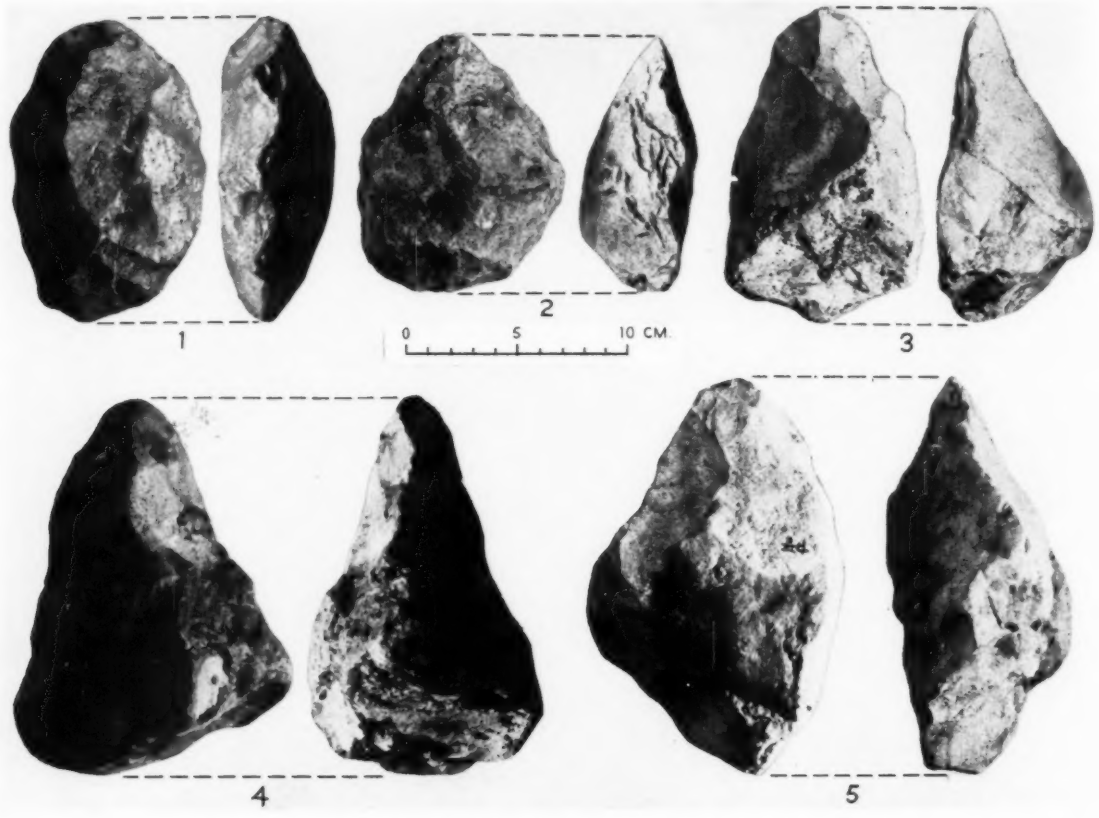


FIG. 12. Lower Palaeolithic (Patjitanian) implements from South-Central Java. (Courtesy of Dr. G. H. R. von Koenigswald.)

tempt has been made to chip this away. A few massive and steep-ended forms (fig. 14, nos. 1–3), on which the secondary working has been carefully executed, have been recorded; these apparently represent a specialized development peculiar to this site, since they are unknown elsewhere.

HAND-AXES

Originally it was claimed that the Lower Palaeolithic material from the Patjitan site was characterized by hand-axes; in fact several authorities have described the industry as having "Chellean" affinities.[18] However, these tools are by no means common—out of a total series of 2,419 implements from the site, studied by the writer in Bandoeng in May 1938, only 153, or 6.32 per cent, were classified as hand-axes (figs. 12 and 13). Very crude examples (fig. 13, no. 4) [19] made on natural nodules of silicified limestone roughly sharpened at one end are rare. The bulk of the series is made up of forms exhibiting fairly intensive working with either rough angular butts (fig. 12, nos. 3–5; fig. 13, no. 3), or with this area covered with cortex (fig. 13, nos. 4 and 5). A total of 42 are worked completely around the butt-end (fig. 12, nos. 1 and 2). The majority of the forms are roughly oval, but triangular types, limandes, and elongated pick-like implements (fig. 13, nos. 1 and 2) are also present. One example in the latter category (fig. 13, no. 2) measures 27.6 centimeters long and resembles tools found in Stellenbosch II of the Vaal Valley in South Africa.[20] One of the distinguishing features with regard to the Patjitanian hand-axes is the character of the chipping. This has been carried back longitudinally from the oval

[18] Compare von Koenigswald, 1936*c*; 1936*d*; 1937*a*; 1939*a*; Teilhard de Chardin, 1937*d*; van der Hoop, 1938: 21–22; 1940: 58, 62–70; 1941: 5–13.

[19] See also von Koenigswald, 1936*c*: pl. XLVI.

[20] van Riet Lowe, 1937: pl. XVII, fig. 1. At the first Pan-American Congress on Prehistory, held at Nairobi during January 1947, it was resolved to recommend that use of the term Stellenbosch be discontinued. On the basis of the new terminology, this stage of development of the great hand-axe culture of Africa should now be called Chelles-Acheul. (See *Nature* **159** [4042], 1947: 547; Fagg, 1947: 156, Oakley, 1947: 256; van Riet Lowe, 1948: 5.)

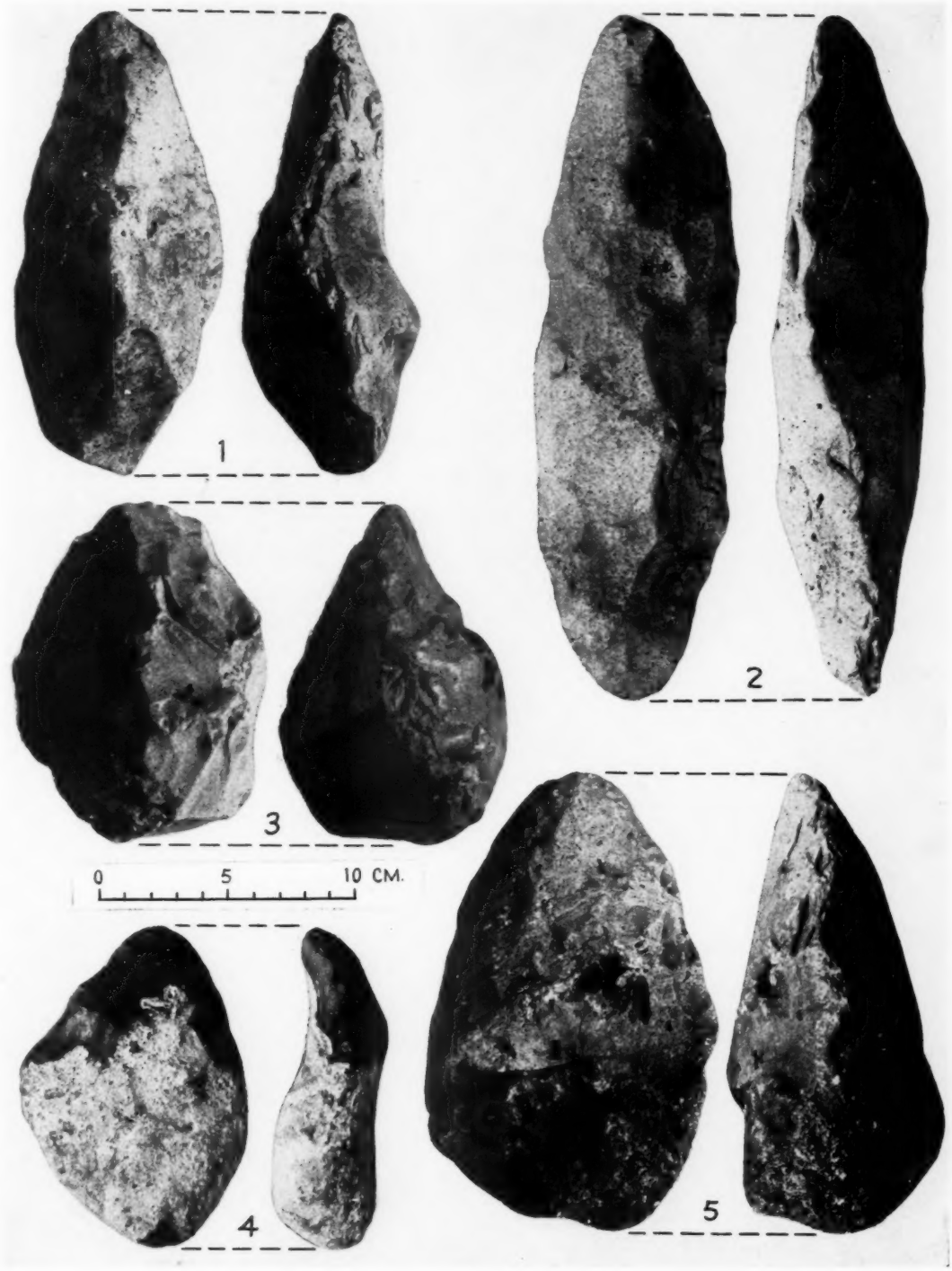


FIG. 13.—Lower Palaeolithic (Patjitanian) implements from South-Central Java.
(Courtesy of Dr. G. H. R. von Koenigswald.)

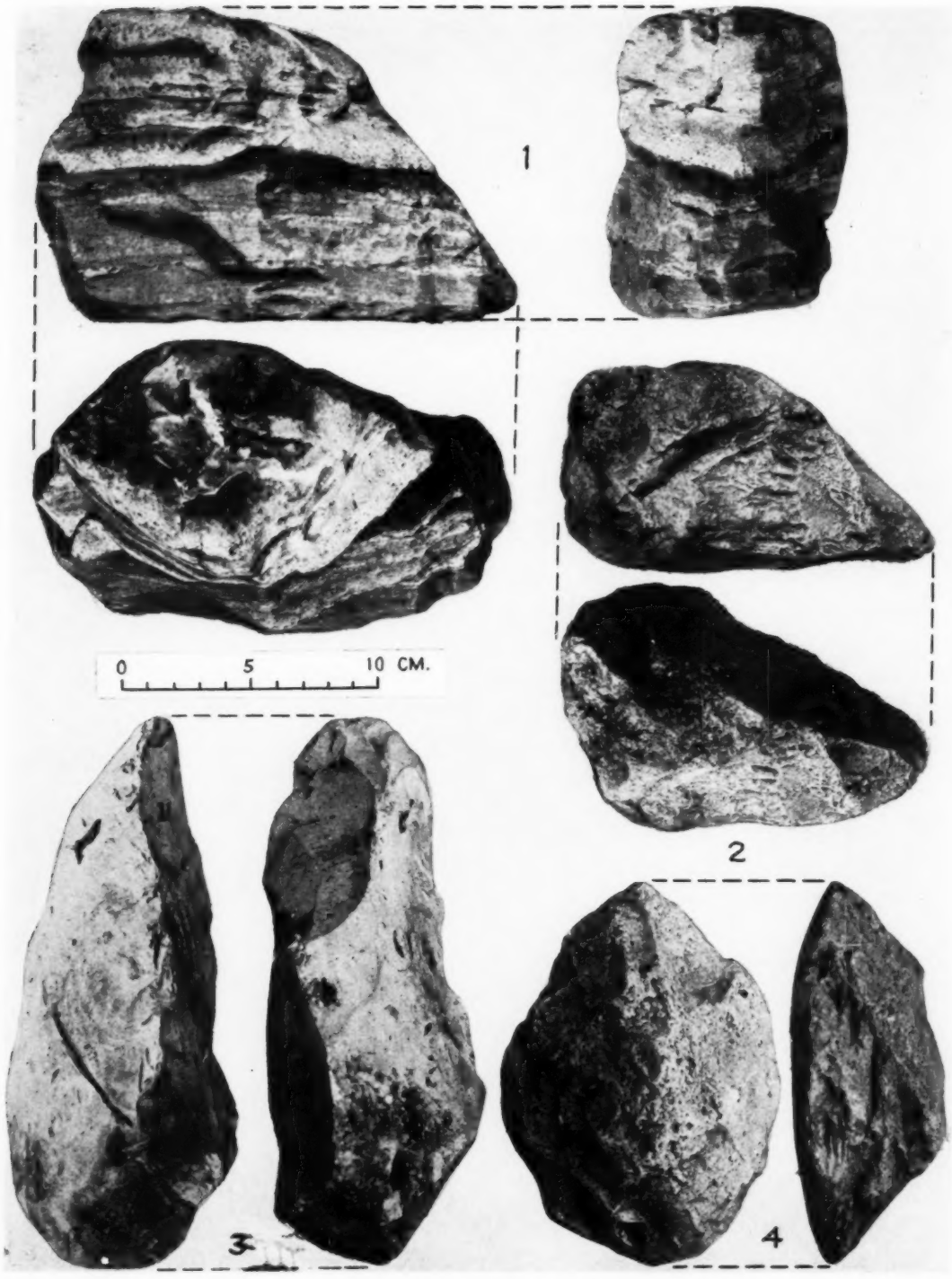


FIG. 14. Lower Palaeolithic (Patjitanian) implements from South-Central Java.
(Courtesy of Dr. G. H. R. von Koenigswald.)

or roughly pointed end, parallel to the main axis of the implement. In the cases of the implements illustrated in figure 12, number 3 and figure 13, number 3, this feature is very clearly shown. In general, one may state that there is nothing characteristically Acheulean about the Javanese specimens. Rather, some of them recall an extremely crude series of Abbevillian types, although the longitudinal flaking is a special feature. It does not seem unlikely, therefore, that the hand-axe, or at least an implement of the hand-axe type, was evolved in Java from tools of the chopper or chopping-tool variety. To support this suggestion the following two possible lines of typological development may be considered:

Choppers → Hand-Adzes → Proto-Hand-Axes → Hand-Axes (Pointed Type)

Chopping-Tools (with alternately flaked edges) → Oval Bifacial Chopping-Tools → Hand-Axes (Oval Type)

Each of the above categories of tools is entirely arbitrary, and admittedly the various classes of implements grade into one another almost imperceptibly. Indeed it is impossible to draw a rigid line between any of them. This fact, in addition to the higher numerical frequency of the prototype in all but one instance, strongly suggests that the type of hand-axe with longitudinal flaking found at Patjitan may have developed independently in Java. For the true *biface*, a common feature of the Lower Palaeolithic Madrasian culture of Peninsular India, is absent, a fact which Professor Breuil pointed out to the writer. This observation is in accord with the evidence from Burma (see p. 374), where the hand-axe appears to be lacking, and where the Lower Palaeolithic is not as highly developed as in Java. For, if there were a direct cultural relationship between the Patjitanian and Madrasian, then hand-axes should be present in abundance in the Irrawaddy Valley. With this important exception, however, the Patjitanian is fundamentally identical with the Early Anyathian. In view of the new evidence, therefore, it seems difficult to avoid the conclusion that in Java a type of pointed bifacial implement was evolved to serve a similar function, but which was otherwise unrelated to the classic *coup-de-poing* of Europe, the Near East, India, and Africa.

FLAKE IMPLEMENTS

In the Patjitanian, flakes of all types, as well as a few true blades, play an important role (fig. 15, nos. 1 and 2; fig. 16). Most of these are well struck, and the scars on the upper surface demonstrate careful preparation on the core prior to detachment. Plain striking platforms at a high angle to the long axis of the implement—the so-called "Clacton" technique—are very characteristic (fig. 15, nos. 1 and 2; fig. 16, nos. 3 and 4). In addition, there are some fifty-eight specimens with definitely faceted butts (fig. 16, nos. 1 and 2). These may be either flakes on which a pseudo-Levallois appearance has been produced as the result of secondary trimming of the bulbar end subsequent to removal from the core (fig. 16, no. 2), or flakes that have actually been detached from cores with previously prepared striking platforms (fig. 16, no. 1). The latter seldom exhibit more than three main facets, and they do not display any particular Levalloisian aspect, although they are suggestive of it. It is significant that no true tortoise cores or discs, both invariably associated with the true Levalloisian, have ever been collected at Patjitan site, nor are the flakes with faceted striking platforms themselves of any special uniform type. For these reasons, it seems highly probable that some of them are to be regarded either as the normal by-products of the process of axe and/or chopping-tool manufacture, or objects struck from tabular cores, the striking platforms of which had been roughly prepared, perhaps fortuitously. Therefore, while Levallois-like flakes, or rather flakes that suggest Levallois types, are present at Patjitan, the classic Levalloisian technique itself is absent.

True flake implements are very numerous; for the most part they seem to have been used as scrapers (fig. 15, nos. 1 and 2; fig. 16, no. 2), points (fig. 16, no. 3), and perforators (fig. 16, no. 5). In some cases the latter display inverse retouch. Several categories of scrapers may be recognized—side, concave, and end (rare), as well as a few large disc-shaped types that are made on carefully trimmed flakes. The points, which include triangular and leaf-shaped forms, clearly reveal the highly advanced flaking technique characteristic of the Patjitanian. Many of the flakes that have not been retouched as implements exhibit edge-chipping as a result of use. As regards size, the degree of variation is tremendous—Dr. von Koenigswald's collection includes "gigantoliths" (fig. 15, no. 3), enormous flakes over 30 centimeters long and weighing up to 7 pounds, as well as small, parallel-sided blade-like tools (fig. 16, nos. 6 and 7). Although a few of the specimens classified as "gigantoliths" have been worked along the edges, the majority of them are sharp, unretouched primary flakes, produced by the shattering technique described on page 355. For this reason they probably should be considered as representing the raw material intended for manufacture into choppers, proto-hand-axes, etc. On the basis of the evidence from this site, where over 1,400 flakes and crude blades (58 per cent of the total series of 2,419 implements) have been recorded, it is manifestly impossible to assign the Patjitanian to either a core- or a flake-tool tradition. For here there is no indication whatsoever that the two traditions developed independently during Lower Palaeolithic times, since flakes exist in abundance side by side with core implements. They both must be considered,

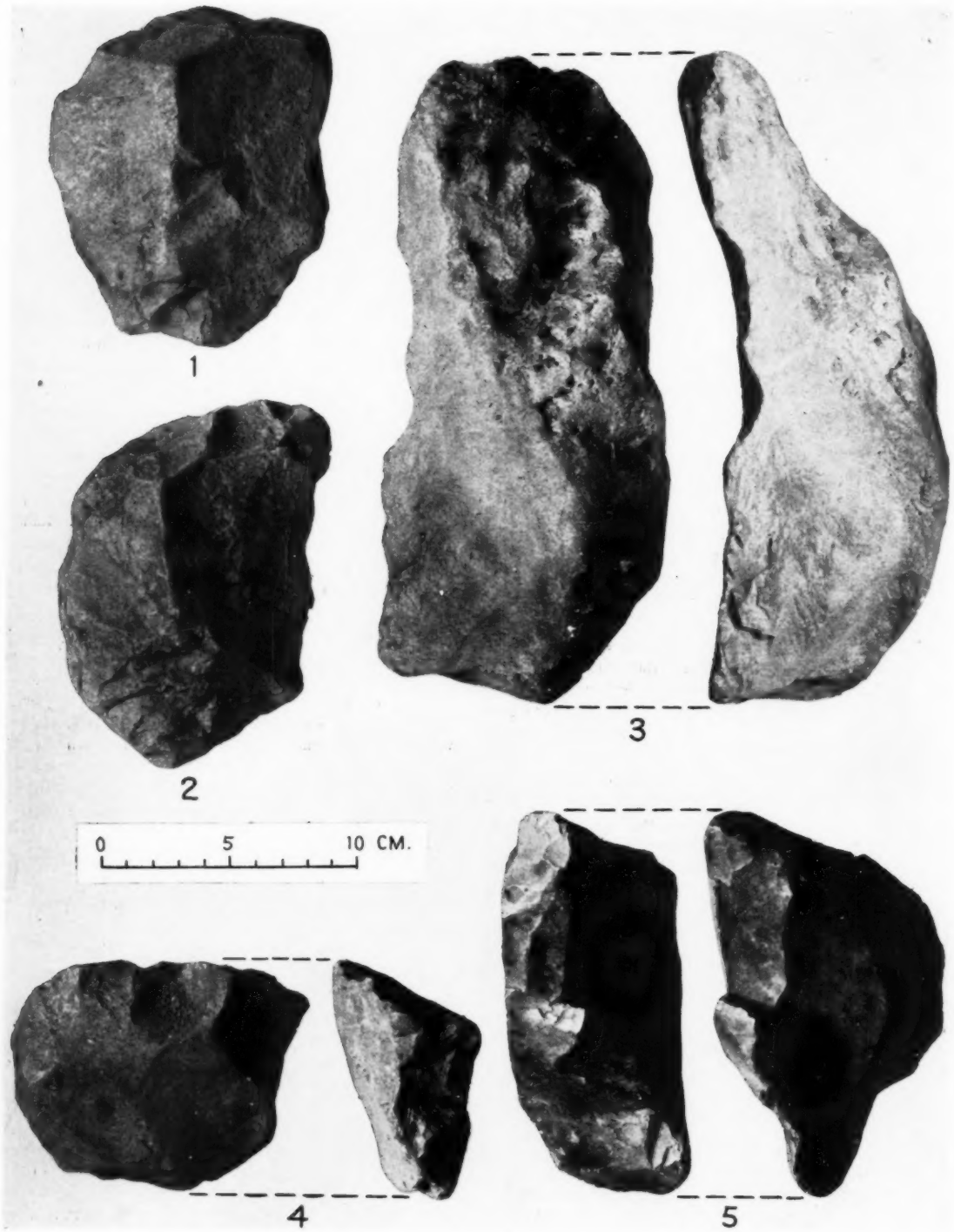


FIG. 15. Lower Palaeolithic (Patjitanian) implements from South-Central Java.
(Courtesy of Dr. G. H. R. von Koenigswald.)

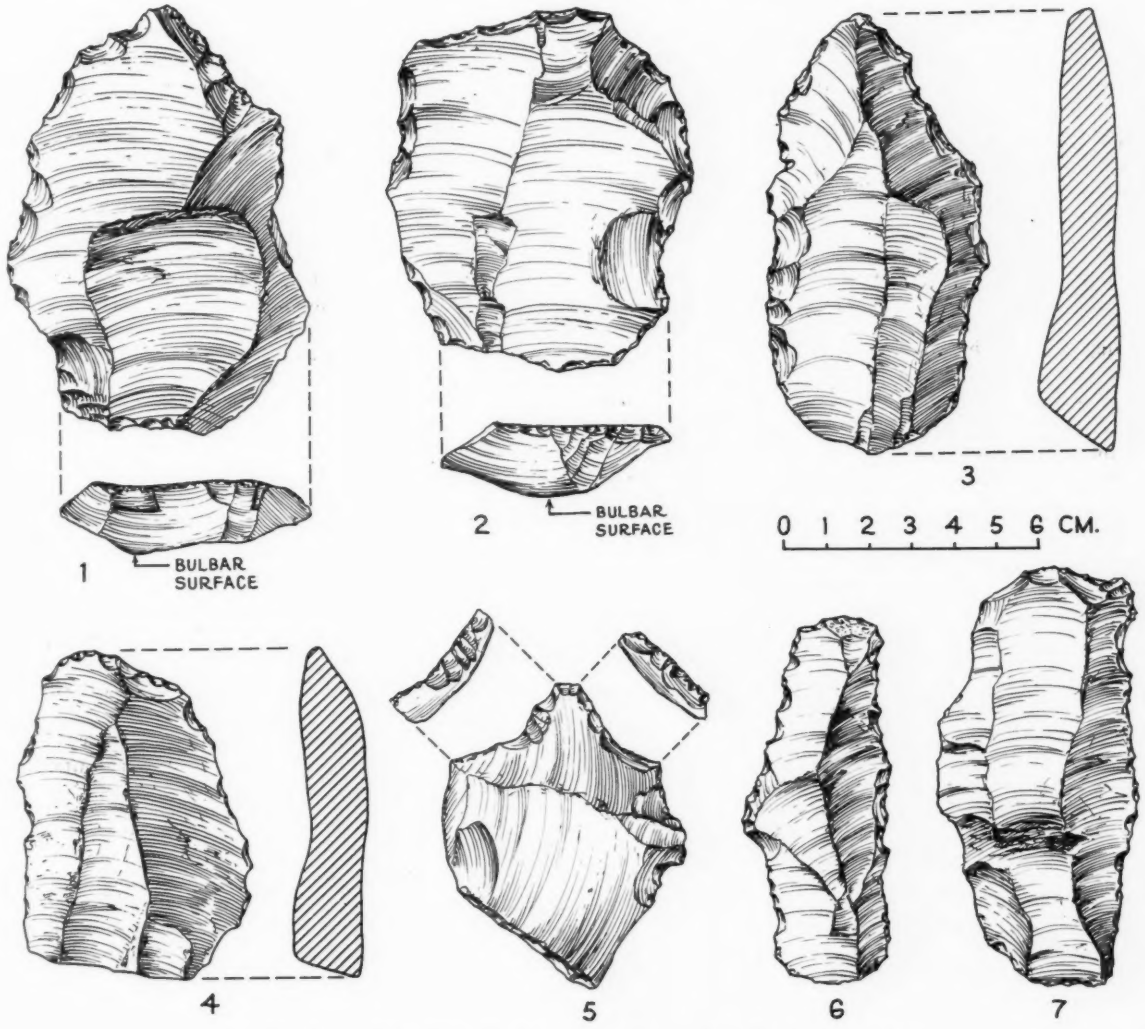


FIG. 16. Lower Palaeolithic (Patjitanian) implements from South-Central Java. (Courtesy of Dr. G. H. R. von Koenigswald.)

therefore, as an intrinsic part of one and the same culture.

CORES

Notwithstanding the overwhelmingly high proportion of flakes and blades, cores or nuclei (fig. 15, nos. 4 and 5) are extraordinarily rare. Since only thirty-one ordinary cores have been collected to date, it is very probable that most of the material used in the process of implement manufacture was obtained directly from the large natural boulders that abound in the bed of the Kali Baksoka. Many of these exhibit scars indicating that flakes have been intentionally detached. The ordinary cores often display parallel flake scars (fig. 15, no. 5), and in some cases striking platforms that have been prepared to a greater or less degree (fig. 15, no. 4). Flakes detached from cores of this latter type naturally would have faceted butts, but this does not necessarily mean that they should be considered as "Levalloisian" types. In addition there are a few cores which are in reality huge flakes, and from which in turn smaller flakes have been detached.

SUMMARY AND CONCLUSIONS

On the basis of the foregoing, it is clear that the Patjitanian of Java does not belong to the true hand-axe culture-complex of Europe, Africa, the Middle East, and Peninsular India. Rather, as stated elsewhere, its

affinities lie with the great chopper—chopping-tool development of Southern and Eastern Asia.[21] Indeed, as van Stein Callenfels first suggested,[22] the Lower Palaeolithic of Patjitan is very reminiscent of the Early Soan of the Punjab in Northwestern India. Certainly its affinities here are far stronger than any that can be demonstrated on the basis of present evidence with the Madrasian of Southern India on the one hand, or with the Abbevillian (Chellean) of Europe on the other. It is interesting to note that the Patjitanian seems to be associated in part at least with Dr. von Koenigswald's "Sino-Malayan" fauna in the Zuider karst region,[23] as well as, perhaps, with *Pithecanthropus erectus*. Although judging by European and South Indian standards the archaeological material from the Baksoka Valley is massive and crude, it is, nevertheless, more evolved on the whole than any of the other Lower Palaeolithic cultures discovered thus far in the Far East. This fact is manifest by the presence of hand-axes (bifacial implements developed from chopping-tools and/or pointed choppers), a variety of well-made flake implements, and even a few coarse blades. That such a development should have occurred in Java, a region that is peripheral with respect to the distribution of the chopper—chopping-tool complex as a whole, is what one would least expect. For this reason, it seems quite possible that the high quality of the raw material (silicified tuff in the main) from the Baksoka Valley, as compared, for instance, with the impurities found in a very similar rock in Upper Burma, should be considered an important contributing factor. In any event, it is patently clear that the Patjitanian tools are better made on the whole and reveal a greater typological range than in the case of comparable cultural developments in Northern China, Upper Burma, Northwestern India, or Malaya. Since Lower Palaeolithic implements of Patjitanian type are also known from three other sites in Java—Gombong and Parigi (Houbolt Collection),[24] as well as southwest of Soekaboemi (D. Erdbrink Collection)—this island, in addition to its importance to students of fossil man, seems to offer a very fertile region for future research in the field of prehistoric archaeology, of which it is to be hoped that every advantage will be taken.

V. THE EARLY ANYATHIAN CULTURE OF BURMA

Since the last century archaeological interest in Burma has been focused on the central portion of the Irrawaddy Valley, through which flows one of Asia's great rivers draining the highlands of Eastern Tibet and the Northern Shan Plateau (map 1). In 1894 Dr. F. Noetling announced that he had found human artifacts *in situ* in an Upper Miocene or Lower Pliocene horizon at Yenangyaung, Upper Burma.[1] Whereas none of the subsequent investigators of this locality challenged the human origin of the specimens, several competent geologists and archaeologists pointed out that identical artifacts occurred in abundance on the surface of the plain some 100 feet above Noetling's alleged implementiferous stratum.[2] This latter observation was confirmed by various members of the Joint American Southeast Asiatic Expedition during the 1937–1938 season's field-work;[3] in fact definite evidence was obtained proving that the material in question is Post-Pleistocene in age and that it belongs to a Neolithic culture.

The first Palaeolithic tools from Burma were discovered by Mr. T. O. Morris of the Geological Survey of India during the early 1930's.[4] Subsequent work in that country by the Joint American Southeast Asiatic Expedition for Early Man has led to the recognition of a new Lower Palaeolithic culture—the Anyathian—which is devoid of hand-axes.[5] Anyathian implements

[21] Movius, 1944: 93.

[22] van Stein Callenfels, 1938: 98.

[23] von Koenigswald, 1939*c*.

[24] Houbolt, 1940: 615. In addition to his collections from Gombong and Parigi, at both of which localities many types of implements very similar to, or even identical with, those from Patjitan were found, Houbolt (*loc. cit.*) has recorded a proto-hand-adze-like tool from the valley of the Moengoep River near Tambangsawah, a village located some 52 miles due north of Benkoelen in Southwestern Sumatra (see map 1). This may well be an indication that a Lower Palaeolithic development comparable with those of Java and Malaya (see p. 403), also took place in Sumatra; in any case, the clue afforded by this single isolated find should be followed up.

A second find from Sumatra which is also in urgent need of further investigation concerns what is claimed to be a Pleistocene fossil human skull (*Homo kamparensis*), discovered in 1938 in the upper valley of the Kampar-Kanan River in Central Sumatra (Schnitger, 1940). Since no illustrations of this individual have yet been published, and since the region has never been investigated by a competent Late Cenozoic geologist, the writer feels that a Pleistocene antiquity for the find has not as yet been demonstrated. Therefore, this alledgedly fossil Indonesian must be carried in the anthropological "suspense account" for the present.

Although almost certainly of Post-Pleistocene age, definite prehistoric human remains have been recorded from Sumatra by Sarasin (1914) and Shurmann (1931). More recently Dr. D. A. Hooijer of Leiden has described two human teeth from the Dubois Collection, which were found in the Lida Ajer Cave, near Pajakombo in Central Sumatra (Hooijer, 1948: 182–187). Although these teeth—an incisor and a molar—do not permit of a final racial determination, Hooijer feels that the molar probably belonged to an individual of the Yellow-Brown race, rather than to a negro or a white (*op. cit.*, 187). In any case, according to Hooijer, there appears to be absolutely no evidence that any of the Central Sumatran caves investigated by Dubois were ever occupied by man. Not only are artifacts completely lacking, but also the mammalian bones and teeth from the cave deposits display no demonstrable traces of working by human agency.

[1] Noetling, 1894; 1897; see also Jones, T. R., 1894; Blanford, 1895; Cole, 1895; Das Gupta, 1923; Mitra, 1927: 124–127.

[2] Oldham, 1895; Swinhoe, 1902; 1903; Pascoe, 1912: 53; Brown, 1931; Morris, 1935.

[3] Movius, 1943: 378–387.

[4] Morris, 1932; 1935; 1936*a*; 1936*b*; 1937.

[5] de Terra, Teilhard, and Movius, 1938; de Terra, 1938*a*; Teilhard, 1938*c*; 1939; de Terra and Movius, 1943; Movius, 1944: 33–44; Burkitt, 1943.

XUM

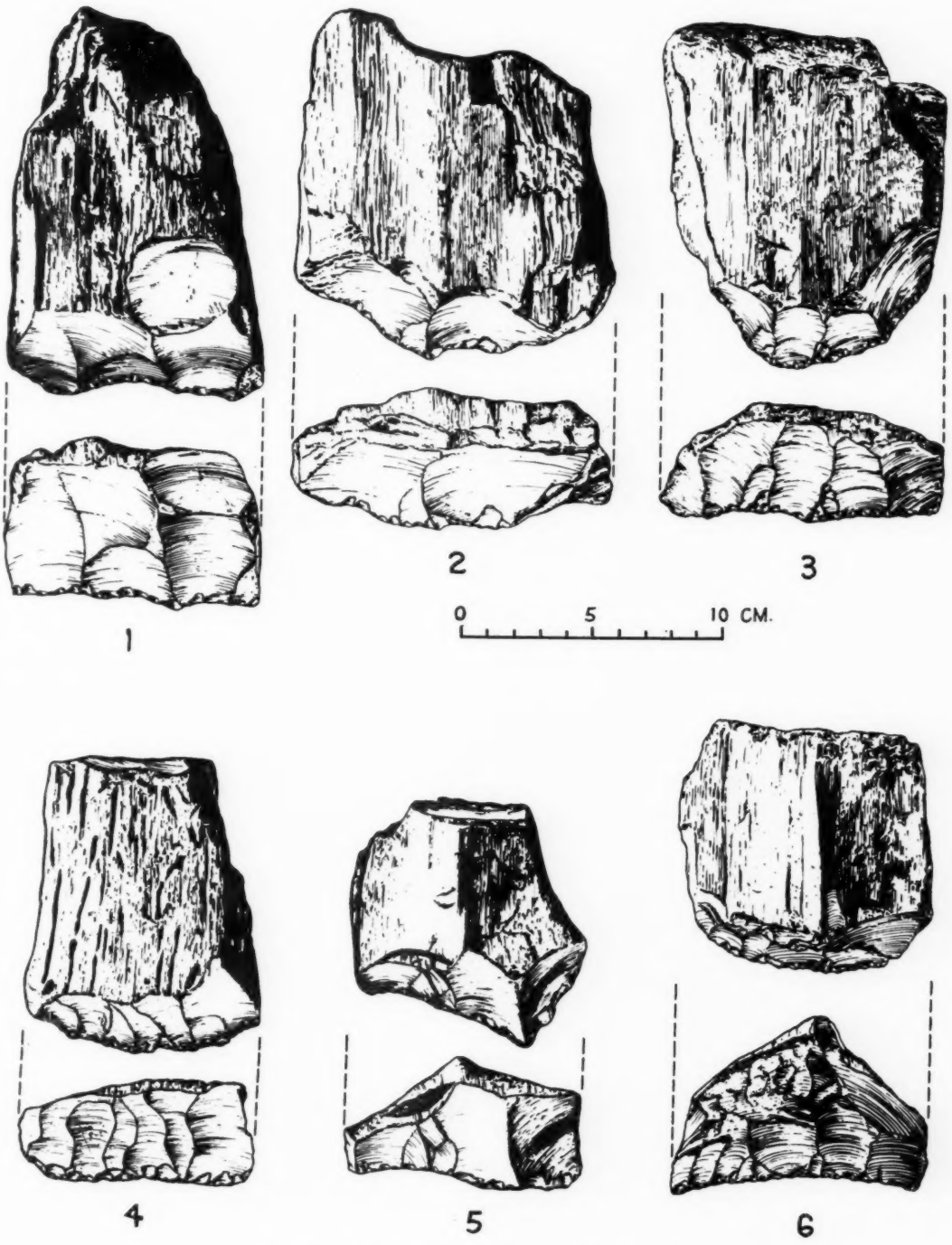


FIG. 17. Early Anyathian implements of fossil wood.

collected by this expedition were all found in the Dry Zone of the Irrawaddy Valley of Upper Burma. To date this new culture has only been identified in secondary deposits—Pleistocene terrace gravels of the ancient Irrawaddy River—and the sites are mostly situated on the east bank of the river. No convincing material was found in the Mandalay Region, although a few implements were collected near Magwe, Minbu, and Pakokku, as well as at Pauk in the Yaw Valley. The principal localities, as shown on map 1, are near Yenangyaung, Chauk, and Nyaungu, a small village near the old capital at Pagan. Two reconnaissance trips to the Shan States failed to reveal any proof that this region was occupied during Pleistocene times.

The three phases of the Early Anyathian culture, which have been established entirely on the basis of stratigraphy, are described in detail elsewhere.[6] Throughout, the tools characteristic of each phase display a surprising degree of uniformity. In part this seems to be due to the nature of the raw material used in the manufacture of a large proportion of the implements, particularly those made of fossil wood. The supply of this rock in Upper Burma is almost inexhaustible, and many thousands of tons of it are present in the Irrawaddian Beds. Since it cleaves easily in a plane parallel to the fibers of the original wood, controlled flaking is difficult, except along a line transverse to the original growth rings of the tree. A few examples, however, which are more highly siliceous than is the normal range of the material, have been flaked in several directions. But the majority of the fossil wood artifacts exhibit working in one plane only. This technique has resulted in the production of an overwhelmingly high proportion of tabular "end" implements of the adze or chopper (massive scraper) variety. Also fairly extensively used by Lower Palaeolithic Man in Upper Burma was silicified tuff. Although some examples of this rock contain numerous impurities and are quite porous, in the main it has a fine-grained homogeneous texture. In addition to having a conchoidal fracture, it possesses the same essential properties as flint, but tests have shown that it is definitely less resilient and at the same time tougher than either flint or fossil wood. In addition, it is less dense than either of these other materials. Nevertheless, it afforded an excellent medium for flaking into an almost unlimited assortment of tools. In all, a total of 483 Early Anyathian implements belonging to Phases 2 and 3 was collected in Upper Burma—261 of fossil wood, 220 of silicified tuff, and 2 of a fine-grained quartzite. In addition to these, 23 Early Anyathian artifacts were found in the Lateritic Gravels and in the gravel deposits of T_1.

In general the degree of rolling is extremely pronounced, although this feature naturally varies considerably in the series as a whole. Similar patinas may be noted both in the case of the silicified tuff and the fossil wood implements. This ranges from a rich, deep brown, to a light reddish brown, russet, or even a dark shade of buff—in a few rare cases almost a cream color. Now the deposits in which the implements are found are heavily charged with ferruginous material, which accounts for the predominant dark ochreous patination that they display. In fact black iron stains, producing a mottled appearance, may be observed on some specimens. Since the typology of the two Early Anyathian series—fossil wood and silicified tuff—differs in certain respects, each will be discussed separately. Some types of implements are common to both series, and this fact will be commented on below.

[6] Movius, 1943: 343–371.

FOSSIL WOOD SERIES

Although over one-half of the Early Anyathian implements collected in Upper Burma are made of fossil wood, the typological range which they display is not great. The relative frequency of the main categories of implements from the T_3 gravels at the three main sites —Yenangyaung, Chauk, and Nyaungu—may be tabulated as follows:

Type of Implement	Total	Percentage of Total
Hand-adzes:		
Single-ended:		
Massive	14	5.36
Large	30	11.49
Medium	40	15.33
Small	59	22.61
Single, steep-ended	35	13.41
Double-ended	20	7.66
Inverse, double-ended	15	5.75
Concave ended	3	1.15
Single-ended and side	3	1.15
Side hand-adzes or choppers	5	1.92
Small scraper with scalloped edge	1	0.38
Chopping-tools:		
Alternately flaked edge	9	3.45
Rounded edge	4	1.53
Single and double-ended choppers	21	8.05
Proto-hand-axe	1	0.38
Pick-like implement	1	0.38
Totals	261	100.00

HAND-ADZES

As revealed by the above table, the overwhelming majority of the implements, an actual total of 219 (83.91 per cent), belong to the hand-adze group (fig. 17; fig. 20, no. 3). This is largely a result of the fact that fossil wood breaks naturally in a rectangular shape, as well as the inherent nature of this material as discussed above. The ordinary single-ended type (total: 143 or 54.79 per cent of the entire series) is by far the most common class of tool. These are tabular fragments of rock debris that have been roughly chipped across one end so as to produce a sharp adze-like edge, the other five surfaces being natural. The removal of secondary flakes resulting in the formation of concave flake scars has led to the formation of an edge with a scalloped

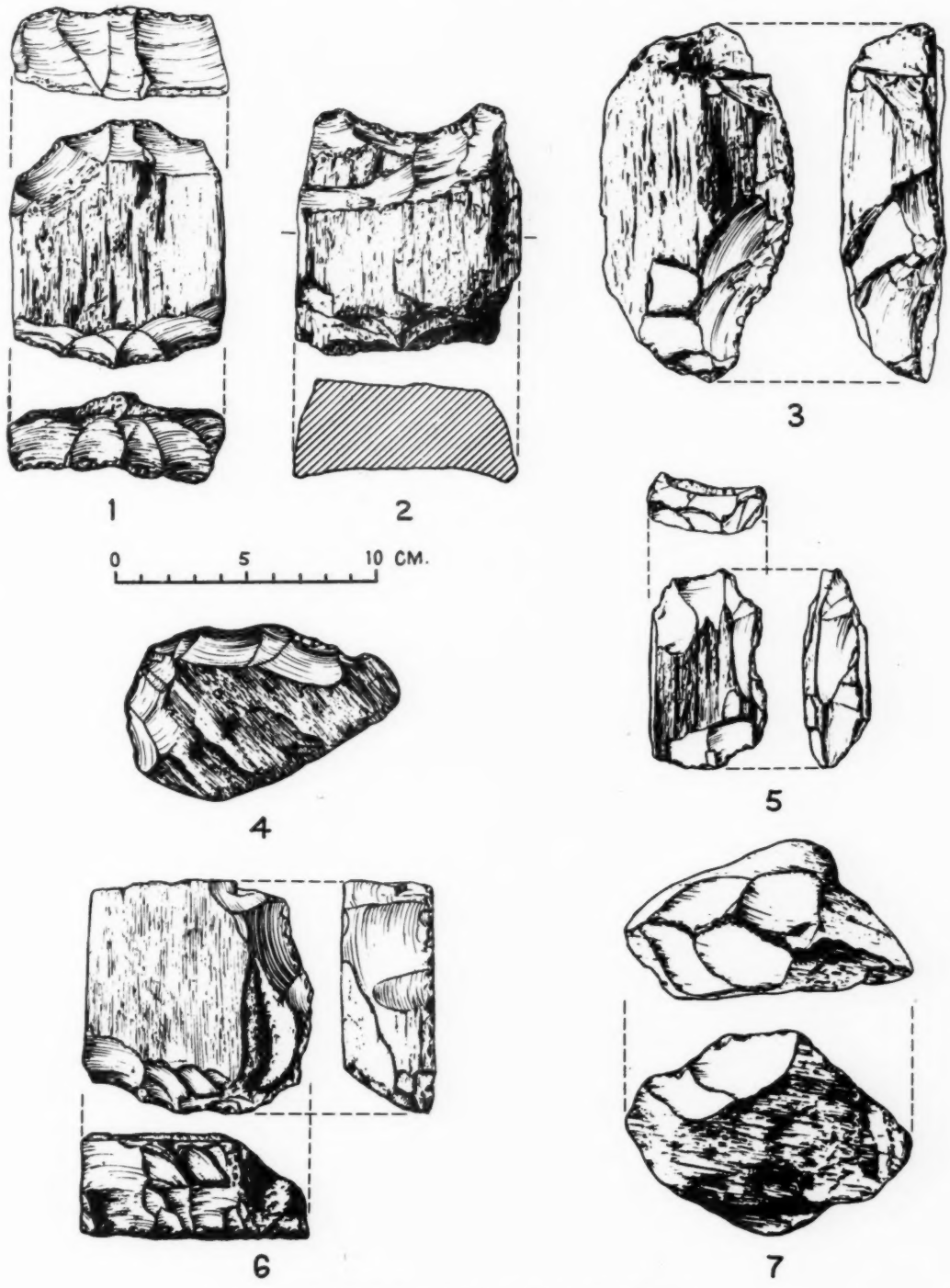


FIG. 18. Early Anyathian implements of fossil wood.

outline in many instances. From point of size, the hand-adzes display tremendous variation, since massive, large, medium, and small (most common) types occur. Square-ended and round-ended forms predominate (fig. 17, nos. 1–4); a few pointed examples (fig. 17, no. 5) are also present, especially in Phase 1 of the Early Anyathian. Although the angle of the cutting edge is normally between 45° and 75°, single, steep-ended types, made on short thick fragments of fossil wood, are fairly common. These latter always have cutting edges that form an angle greater than 75° with the long axis of the implement (fig. 17, no. 6). There are, in addition, other types of hand-adzes which are double-ended (fig. 18, no. 1), and in these the flaking has been executed on both ends upward from the lower surface of the specimen. Also present are inverse, double-ended forms (fig. 19, no. 1) on which one of the cutting edges has been fashioned by the removal of flakes from the lower surface of the implement, whereas in the case of the other the flakes have been struck from the opposite surface downward. The resulting tool is shaped in section more or less like a rough parallelogram. Less elaborate examples, in which an ordinary single-ended hand-adze has been sharpened on the side as well to make a second cutting edge (fig. 18, no. 6), are also found, but these are not common. Although they are comparatively rare, the occurrence of concave-ended types (fig. 18, no. 2) demonstrates that every possible variation of the hand-adze type of implement is included. In addition, a few side hand-adzes, or choppers (fig. 18, no. 3), have been recorded. However, neither these nor true side scrapers (fig. 18, no. 4) are frequent, since it is virtually impossible to execute controlled flaking with the grain of the wood in either a transverse or a longitudinal direction.

SMALL SCRAPER WITH SCALLOPED EDGE

A small scraper or cutting implement of fossil wood (fig. 18, no. 5) was collected in the T_3 gravels at Chauk in February 1938. Secondary working by the technique of alternate flaking has produced an edge with a scalloped outline, caused by the marked projections along the working edge that have resulted from the intersection of the ridges separating the flake scars. A second implement of this type is known. It was found by Mr. T. O. Morris in the Pleistocene gravels at Yenangyaung, and presumably it belongs to the Early Anyathian. Although Mr. Morris' specimen is made of silicified tuff, it is mentioned here, since it is quite definitely not a hand-axe, as originally maintained by the finder.[7] It appears, in fact, to be worked on one side only, although the edge exhibits a markedly "scalloped" appearance.

[7] Morris, 1936*a*.

CHOPPING-TOOLS

A few implements—total: 13 or 4.98 per cent of the entire series—that may definitely be classed as chopping-tools occur in the Early Anyathian. Nine of these specimens exhibit alternately flaked edges (fig. 18, no. 7). Most of the implements of this type are made of silicified tuff, as will be described below, and their presence in the fossil wood series is, therefore, interesting. There are also several very crude chopping-tools with edges that have a convex or rounded outline (fig. 19, no. 4). These represent conscious attempts on the part of the artificer to execute secondary working irrespective of the grain of the wood.

CHOPPERS

This same tendency may be noted in the case of some crude choppers, which are either single, or double-ended (fig. 19, no. 3). In all, a total of 21 of these implements (8.05 per cent of the entire series) was collected in the T_3 gravels of the Irrawaddy Valley. These fossil wood choppers, along the edges of which very coarse resolved flaking is often present, appear to be crude attempts to manufacture tools that are normally made of silicified tuff.

PROTO-HAND-AXE

Only one implement in this category (fig. 19, no. 2) was found in Upper Burma, and it seems a curious fact that it should be of fossil wood. In a sense this specimen may be considered a pointed and double-sided (triangular) chopper. Nevertheless, the secondary working has been executed without regard to the grain of the wood. As stated on page 355, implements of this type are fairly common in the Patjitanian of Southern Java.

PICK-LIKE IMPLEMENT

The crudely pointed end of this very large tool (length: approx. 25 cm.) has been formed by the removal of large flakes extending only a short distance back in the direction of the butt. This gives the implement (fig. 20, no. 4), which is unique in the collection from Upper Burma, a pronounced shouldered appearance.

These categories of implements complete the entire range of the Early Anyathian fossil wood series, in which the bulk of the specimens are large and massive —over 10 centimeters in the longest dimension. It will be noted that true bifacial types are completely absent, as are cores or nuclei and flakes. A careful study of the collection, as well as experimentation in the field, clearly demonstrates that the inherent nature of the fossil wood itself must be regarded as the dominant factor controlling the typology of the fossil wood series, composed as it is almost entirely of implements of the hand-adze variety. But this observation emphatically does not apply to the specimens made of silicified tuff.

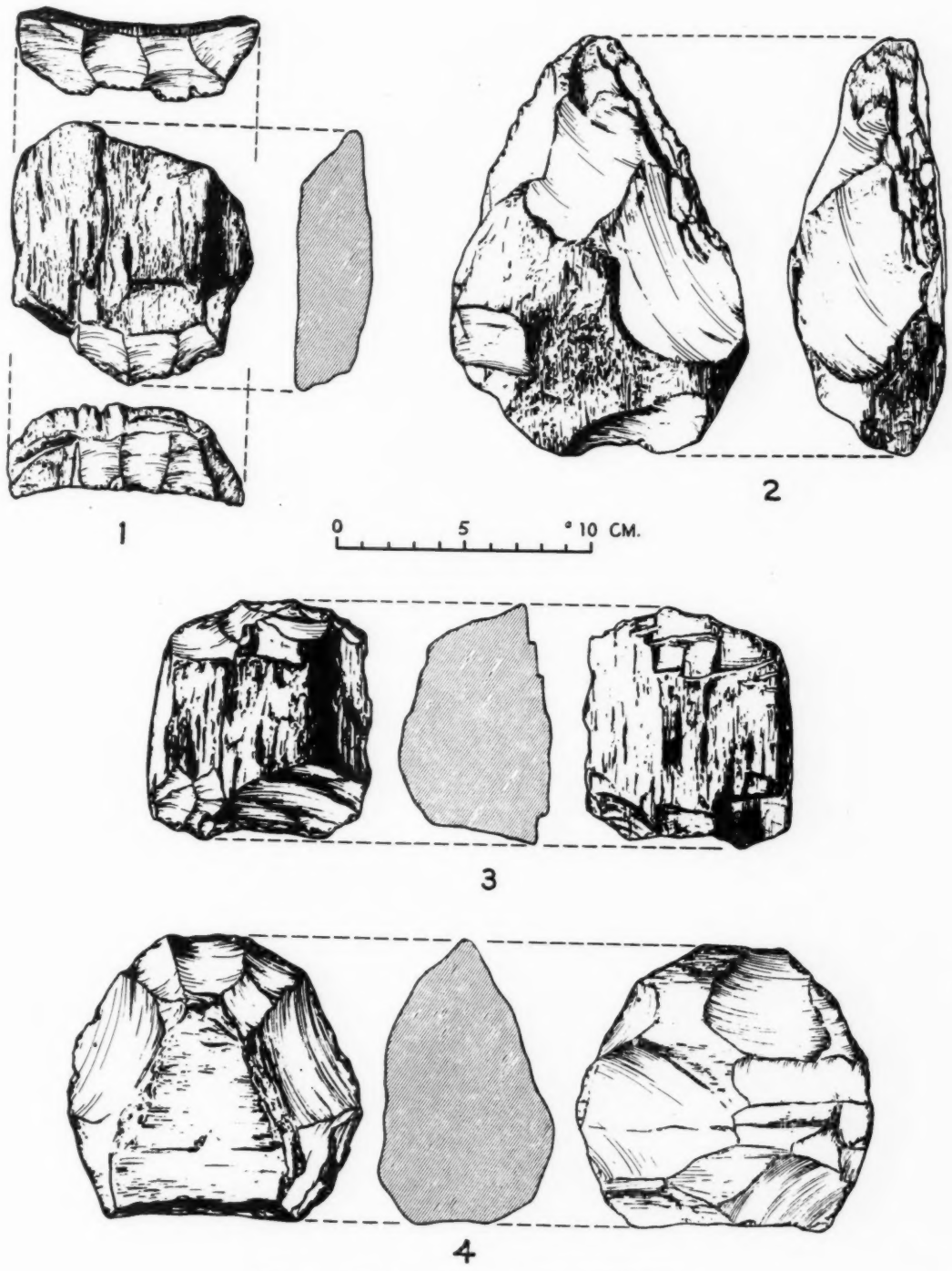


FIG. 19. Early Anyathian implements of fossil wood.

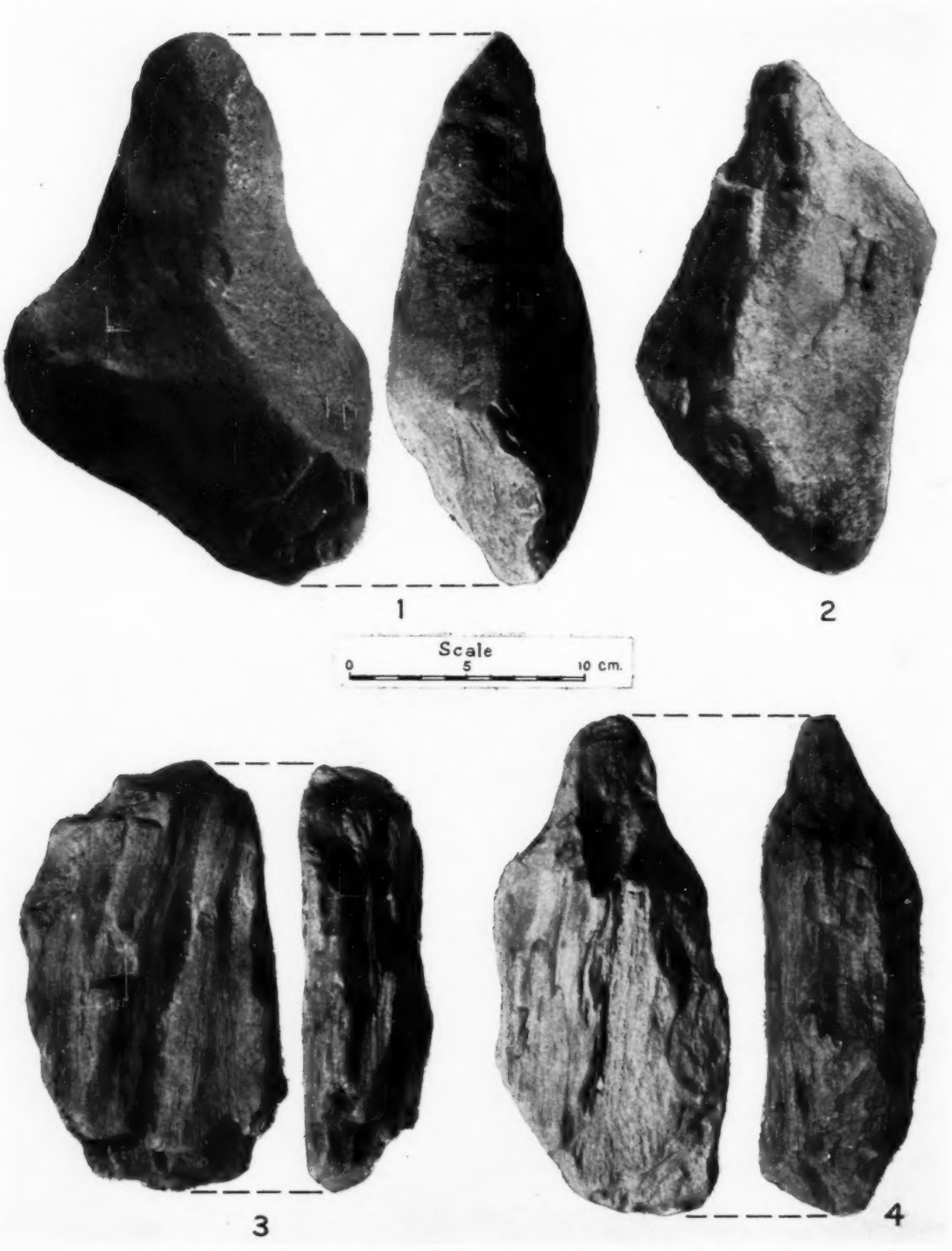


FIG. 20. Early Anyathian implements of silicified tuff (*upper*) and fossil wood (*lower*).

SILICIFIED TUFF SERIES

In the main the tools made of silicified tuff are even larger and more massive than those of fossil wood. Typologically the two series differ, as stated above, but they possess one fundamental feature in common, namely, the desire to fashion a cutting edge on either a tabular or round fragment of rock debris with the minimum amount of flaking. The silicified tuff series, however, being made of the more tractable material, displays by far the greater degree of variability as to classes of tool forms and range of types within each class. This fact is clearly shown by the following table in which the relative frequency of the main categories of implements from the T_3 gravels at the three main sites—Yenangyaung, Chauk, and Nyaungu—has been listed:

Type of Implement	Total	Percentage of Total
Choppers:		
Flaked only on the upper surface:		
Massive	17	7.73
Large	21	9.55
Medium	22	10.00
Massive triangular implement	1	0.45
Massive pick-like implement	1	0.45
Hand-adzes or choppers:		
Pebble implements flaked on the upper surface:		
Large	6	2.73
Medium	7	3.18
Tabular hand-adzes (fossil wood type)	15	6.82
Chopping-tools:		
Alternately flaked edge	17	7.73
"Overthrust" edge	11	5.00
Implements made on flat pebbles	13	5.91
Chopping-tools or (?) cores	2	0.90
Flake implements:		
Massive	11	5.00
Large	13	5.91
Medium	9	4.09
Cores or nuclei:		
Large	21	9.55
Medium	21	9.55
Small	12	5.45
Total	220	100.00

CHOPPERS

In this category, which includes the largest number of implements in the silicified tuff series (total: 61; 27.73 per cent of the entire series), the overwhelming majority of the tools exhibit working edges that have been flaked on the upper surface only (fig. 21, nos. 1, 2, and 5). As revealed by the illustrated specimens, the range of types within this class is considerable. Choppers are normally made on river pebbles, of which angular to sub-angular, flat, and rounded forms occur in the gravels. The flaking is usually restricted to the end or one side of the artifact; on some specimens, however, it may extend around three sides (e.g., fig. 21, no. 5). Elsewhere on the surface the original cortex of the pebble remains. Along the cutting edge, which may be either convex, straight, or even concave, edge-chipping and/or stepped flaking as a result of use is apparent. Some of the choppers are very large; in fact one massive triangular example (fig. 20, no. 1), which measures 23.5 centimeters in its longest dimension, was found. In the case of this implement, which is made on a pebble that originally possessed a triangular outline, each of the three sides has been worked. No attempt has been made, however, to produce a bifacial type of tool which might be classified as a hand-axe, or even a proto-hand-axe.

MASSIVE PICK-LIKE IMPLEMENT

Only one implement made of silicified tuff which may be classed as a pick (fig. 20, no. 2) was found in Upper Burma. It is a far more massive specimen than the fossil wood example (fig. 20, no. 4) described above. Made on a large sub-angular pebble of tuff approximately 20 centimeters long, it possesses a roughly triangular section. The flaking extends from the point in the direction of the butt.

HAND-ADZES

A total of 28 implements (12.73 per cent of the entire series) may be classed as hand-adzes, although some 13 of these could equally well be placed in the chopper category. These latter tools are made on pebbles which are relatively thick in proportion to their length (fig. 21, nos. 3 and 4). The cutting edge, which is more or less straight on these steep-ended forms, is formed by the detachment of flakes from the lower surface. True tabular hand-adzes are also represented (fig. 21, no. 6), and they are indistinguishable, with the exception of the material from which they are made, from the type implement of the fossil wood series.

CHOPPING-TOOLS

Chopping-tools, the second largest category of Early Anyathian implements (total: 41; 18.64 per cent of the entire series), were more common at Yenangyaung than at any of the other sites in Upper Burma. As previously mentioned, the type with an alternately flaked edge (fig. 22, nos. 1–5) may be considered the most characteristic implement of the Early Anyathian culture. Crude examples of these occur in Phase 1 of the Early Anyathian, which is found in the early Middle Pleistocene gravels of T_1 and in the Lateritic Gravel on the peneplain.[8] They are made on pebbles, and the edge is formed by the removal of two main flakes on one side of the implement and three on the other, by a process known as alternate flaking. This process entails the detachment of flakes along either side of the cutting edge in such a way that the bulbs of percussion found on any given side are situated directly opposite the ridges between the flake scars on the other side. Thus, if a total of seven main flakes have been detached, as in the case of the specimen illustrated in figure 22, number 1, a VVV-shaped edge will result. In this

[8] See Movius, 1943: 353, fig. 57, no. 4.

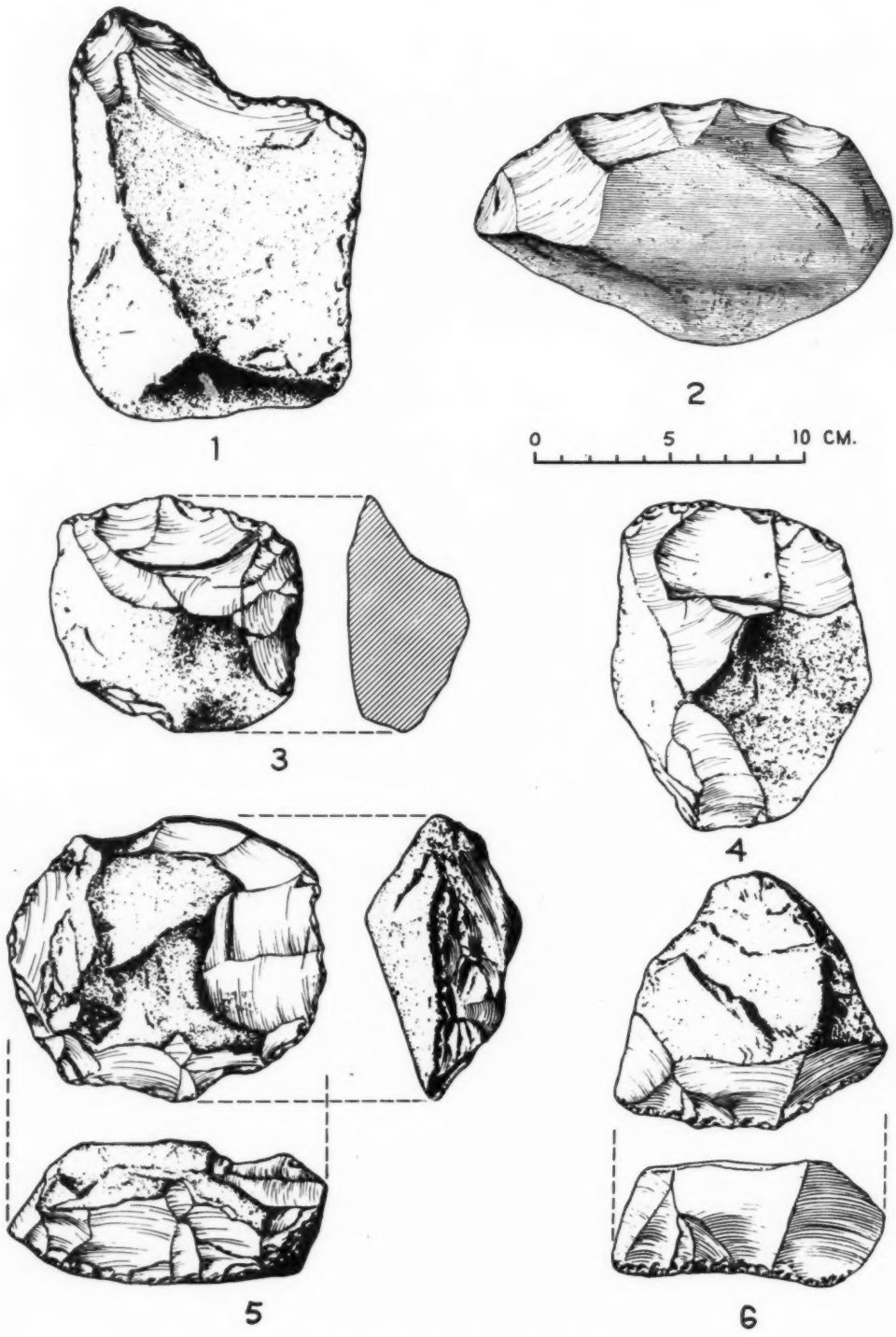


FIG. 21. Early Anyathian implements of silicified tuff.

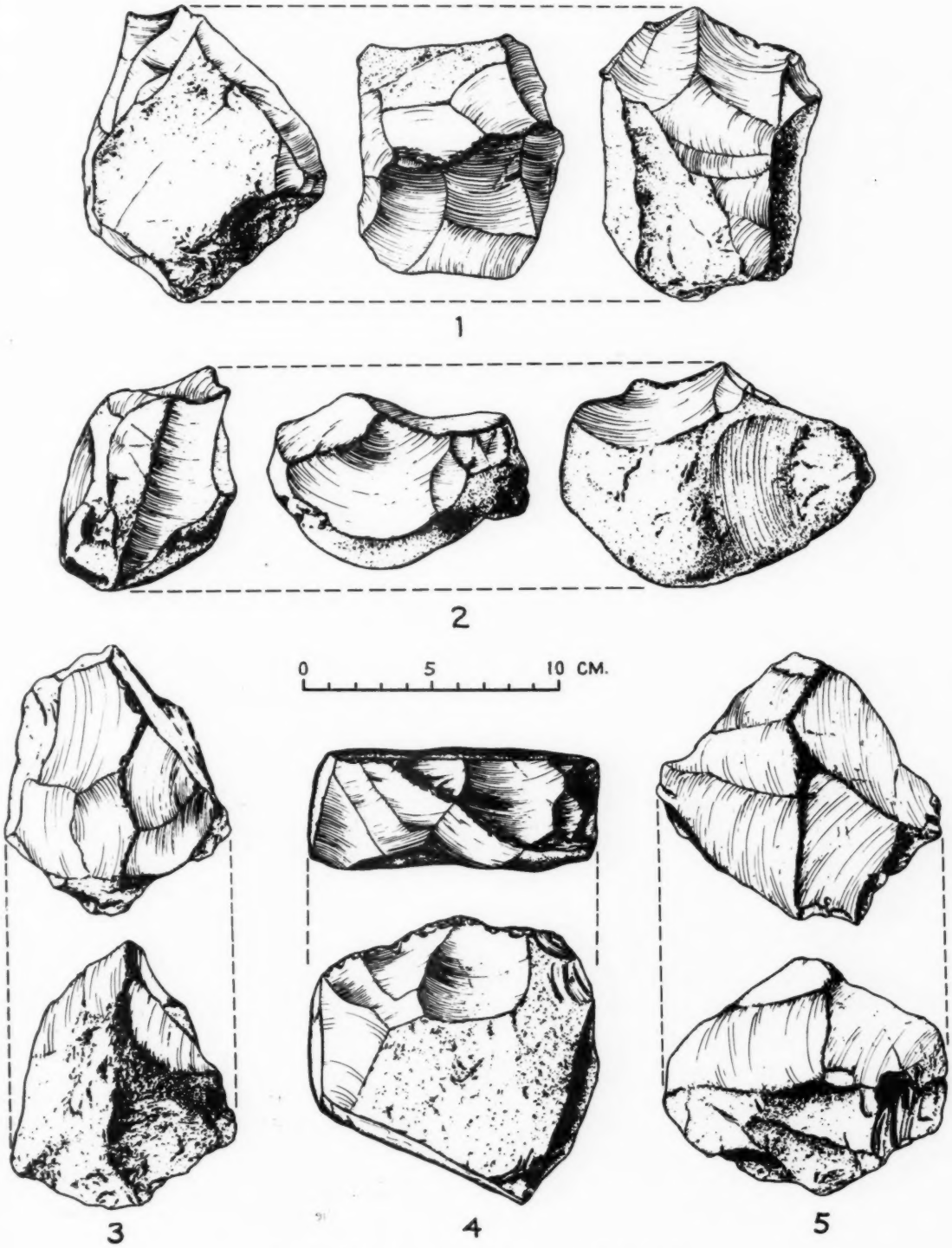


FIG. 22. Early Anyathian implements of silicified tuff.

manner a very effective chopping-tool may be produced, which, with the exception of the fact that it lacks a point, can be considered fully as effective a cutting implement as the classic hand-axe. The working edge of these implements, battered and chipped by use, usually forms an acute angle of less than 70°. But chopping-tools with high angle (75°–85°) cutting edges also occur (fig. 22, no. 5). These are likewise made on pebbles, and when viewed from above some of them (total: 11; 5.00 per cent of the entire series) display a markedly pointed projection or beak at the mid-point (fig. 22, no. 2). For this reason, they are referred to as chopping-tools with an "overthrust" edge —a specialized type thus far known only from one site in Upper Burma, although a few occur in the Patjitanian of Java, as stated on page 356.

Not all the chopping-tools associated with the Early Anyathian have been made by the process of alternate flaking. Approximately one-third of the tools in this category are made on flat, oval pebbles, also with bifacially worked edges, but not necessarily alternately flaked (fig. 22, no. 4). These probably served fully as effectively for cutting implements as did those made by the more evolved technique. This type of chopping-tool is very reminiscent of examples made from other types of rock and found in the famous *Sinanthropus* deposits at Choukoutien, near Peking, in North China.

FLAKE IMPLEMENTS

In comparison with the core tools, flake implements (fig. 23, nos. 1–4) are rare in the Early Anyathian. In fact only 15 per cent (total: 33 specimens) of the entire collection consists of artifacts in this category. In the majority of the cases, the striking platforms are of the plain unfaceted variety, and many of them form an angle greater than 90° with the long axis of the tool. Since the bulbs are pronounced and the cones of percussion are unusually large, it is possible that these flakes were manufactured by the so-called "anvil technique." Experiments with the same material show, however, that direct percussion with a hammer-stone will produce the same result. In any case, none of the flakes associated with the Early Anyathian even remotely approach examples of the classic "Levallois" type. From point of size, implements in this category range from large trimming flakes (fig. 23, no. 1), frequently with cortex on the upper surface and probably used as rough scrapers or choppers, to medium-sized examples which display fairly careful core preparation prior to detachment (fig. 23, nos. 2 and 4). A few large scrapers that have been retouched by stepped or resolved flaking occur (fig. 23, no. 3), but parallel-sided blade implements are absent.

CORES OR NUCLEI

The Early Anyathian cores all display roughly prepared striking platforms formed by the removal of a large trimming flake from one face of a pebble of silicified tuff (fig. 23, nos. 5 and 6). They vary both as to size and relation of the striking platform to the long axis of the nodule. On the whole, there is nothing particularly distinctive about the Early Anyathian cores, of which a total of 54, representing 24.55 per cent of the entire series, was found. In several instances the large cores exhibit edge-chipping as the result of use as chopping-tools. The simple, rather crude flakes characteristic of the Early Anyathian seem to have been struck by direct percussion from large rounded to sub-angular pebbles with roughly prepared striking platforms. A few specimens reveal that a fairly advanced blade technique was likewise employed, but no blade implements or small flakes were found in the T_3 deposits in Upper Burma. Nevertheless, the evidence of the cores demonstrates that both types of artifacts—flakes as well as blades—were made by the Early Anyathian people.

SUMMARY AND CONCLUSIONS

The Early Anyathian of Burma, the main development of which took place in the Middle Pleistocene and the early Upper Pleistocene, can be assigned on clearly defined stratigraphical grounds to the Second Pluvial, the Second Interpluvial, and the Third Pluvial Stages of the Northwest Indian sequence.[9] It is definitely a chopper—chopping-tool—hand-adze complex, the most significant feature of which is the complete absence of bifacial implements of the hand-axe variety. This cannot be explained by the scarcity of good raw material, since the silicified tuff occurs in large boulders. The only logical conclusion, therefore, seems to be that the people responsible for the Lower Palaeolithic of Burma were not users of hand-axes. Instead, chopping-tools and tools of the adze or chopper type comprised the bulk of the stone implement equipment of the ancient settlers in the Irrawaddy Valley. On the basis of the fossil wood series alone, it might be argued that hand-axes are absent because this material does not lend itself to their manufacture.[10] Such an argument cannot be applied, however, to the silicified tuff for the reasons discussed above (see p. 366). As previously stated, the influence of the raw material is considerable, and, although the two series of Early Anyathian implements exhibit certain differences from a typological point of view, there can be no question that each is a contemporary industrial expression, or manifestation, of the same basic culture. This is made evident by the fact that hand-adzes, the type fossil wood implement, occur also in silicified tuff, whereas the chopping-tool with alternately flaked edge, the type silicified tuff implement, is likewise found made of fossil wood. Furthermore, each

[9] See de Terra and Movius, 1943: 330–336 and 343–345; Movius, 1944: 36–40.

[10] The fine series of ovates from Gwelo, an Acheulian site in Southern Rhodesia (Bond, 1948: 56), are made of a very much more highly siliceous type of fossil wood than is included in the normal range of this material found in Upper Burma.

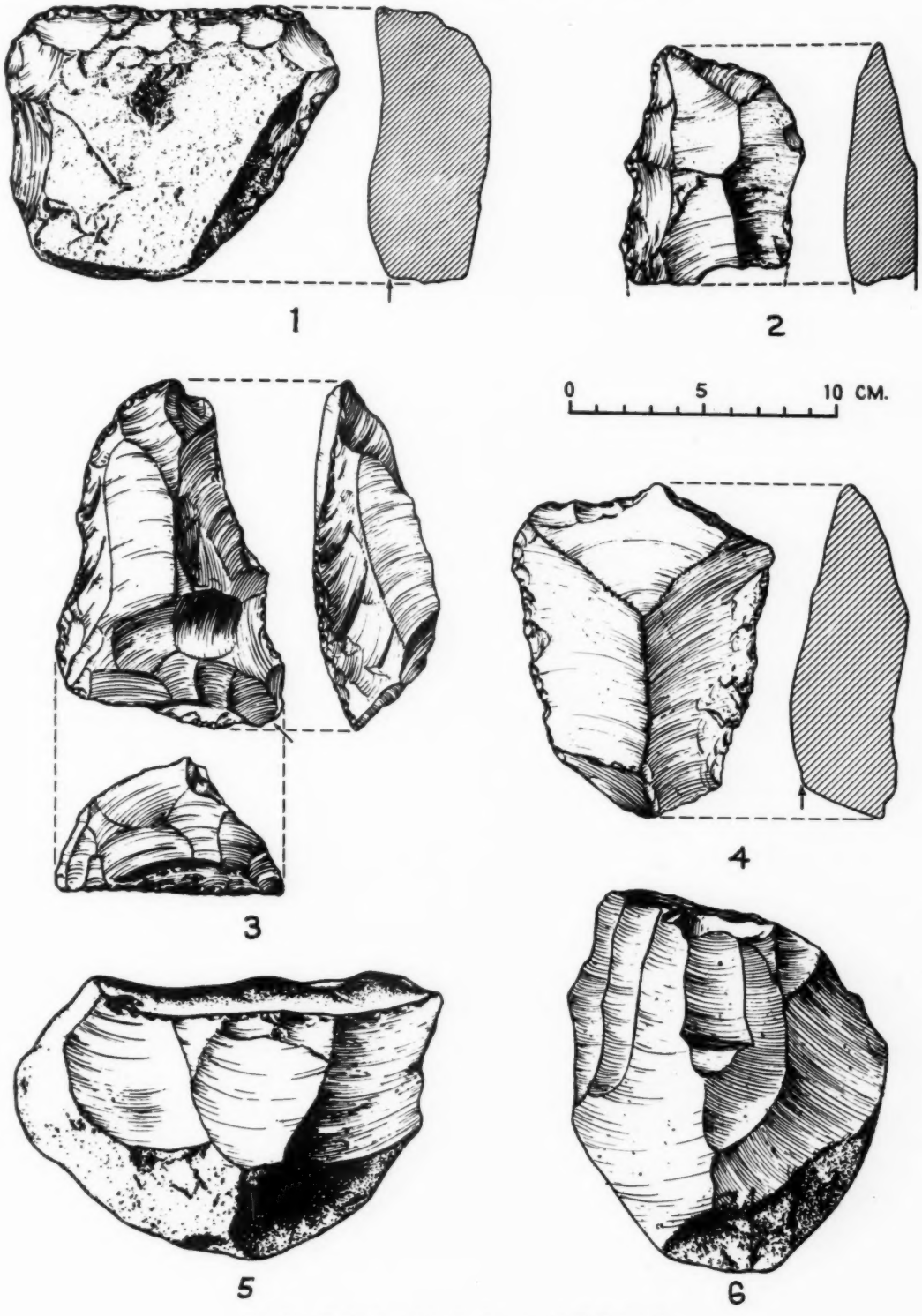


FIG. 23. Early Anyathian implements of silicified tuff.

series is characterized by essentially the same types of tools which persist with little or no typological development throughout. This is perhaps to be expected, since on the basis of the primitive forms displayed by most of the Early Anyathian tools, it seems unlikely that very much typological change could occur. Such evolved implements as hand-axes can and do cover a very wide typological range, but in dealing with choppers and adzes of various categories one can expect only a certain technological refinement, so long as the same fundamental types remained in common use.

Now implements of such primitive aspect as choppers, chopping-tools, and hand-adzes have a sporadic distribution in several regions of the Old World, excluding the Far East, during Lower Palaeolithic times. It is, therefore, the *absence* of developed implements of the hand-axe category, rather than the actual *presence* of typical choppers, chopping-tools, and hand-adzes, which makes the Early Anyathian culture important. In Southern and Eastern Asia, as well as in Northern India, however, the tradition of these primitive types of tools persisted longer than elsewhere. As in the Punjab, where the Late Soan is basically a development of the Early Soan (see p. 383), the Late Anyathian of Burma,[11] although typologically more advanced than the Early Anyathian, contains essentially the same fundamental core implements associated with flakes.

VI. THE PALAEOLITHIC CULTURES OF NORTHWESTERN INDIA

As a result of detailed investigations during the last fifteen years, interest in Early Man in India has been focused on the northern portion of Punjab Province, in particular a plateau area known as the Potwar Region. This elevated mass of Siwalik deposits lies between the Salt Range and the Indus Valley; in the main it is drained by the Soan River, a tributary of the Indus, which flows southwest from the Rawalpindi District. Although the first alleged palaeoliths were reported from the Punjab in 1880,[1] it was not until 1928 that Mr. D. N. Wadia of the Geological Survey of India called attention to the existence of abundant Palaeolithic material in the valley of the Soan River.[2] Two or three years later a very rich Palaeolithic station was reported near Pindi Gheb, Attock District,[3] and in 1932–1933 the Yale-North India Expedition made additional discoveries of human artifacts in Kashmir and the Salt Range.[4] In 1936 Dr. de Terra announced that a new Palaeolithic culture, which he called the Soan, had been found by himself together with Drs. Teilhard de Chardin and T. T. Paterson.[5]

On the basis of the facts obtained to date, it may be stated that all the Palaeolithic stations in Northwestern India fall into three main groups: (*a*) those that yield the large, crude flakes of the so-called "Pre-Soan" Industry; (*b*) those that contain choppers and chopping-tools in a complex called the Soan culture; and (*c*) those that are characterized by hand-axes of Abbevilleo-Acheulean type. Stratigraphically (*a*) is the oldest, whereas (*b*) and (*c*) appear to be of equal antiquity. Although it is with the Soan culture proper, more particularly its early development, that this paper is chiefly concerned, short summaries of the entire Palaeolithic sequence will be included, since this is a fundamental necessity for a proper understanding of the archaeological situation as a whole in this region. For, on the basis of the new evidence obtained in Burma and Java, it now seems apparent that the Soan culture, especially in its early stage, must be regarded as one manifestation of a great complex of chopper—chopping-tool cultures found in Southern and Eastern Asia. On the other hand, the Abbevilleo-Acheulean series, together with the definitely "Levalloisean" increment that is most pronounced in the Late Soan, belong to the more familiar Lower Palaeolithic complex of "Western" affinities.

In the Northern Punjab the raw material available for the manufacture of implements consists in the main of quartzite, which occurs in the form of pebbles and small boulders. In general, it is fine-grained, and the implements made from it display a dull gray patina, although deep brown or even brownish-purple colors may be noted in some instances. A second rock, Panjal trap, was also used in prehistoric times for the production of implements; normally this is patinated in varying shades of greenish-gray. Both these rocks occur in abundance in the Pliocene (Middle Siwalik) conglomerates; in fact the archaeological sites are so closely associated with these outcrops that "one can almost predict sites wherever this formation underlies the peneplain," according to Dr. de Terra.[6] In the Potwar Region, therefore, the supply of good raw material possessing a fracture ideal for making stone tools is almost inexhaustible.

EARLIEST TOOLS

Stratigraphically the earliest human artifacts found in the Potwar Region occur near the top of the late Upper Siwalik Boulder Conglomerate; they are therefore of early Middle Pleistocene, Second Glacial Stage,

[11] For a full discussion of the Late Anyathian, see Movius, 1943: 372–374.

[1] Theobald, 1880; Swynnerton, 1880.

[2] Wadia, 1928: 290 and 346.

[3] Paterson, with de Terra, 1939: 310–311.

[4] de Terra, 1933*a*; Hawkes and de Terra, 1934.

[5] de Terra, 1936; de Terra, Teilhard de Chardin, and Paterson, 1936.

[6] de Terra, with Paterson, 1939: 286. This summary of the Palaeolithic cultures of Northwestern India is based in the main on Drs. de Terra's and Paterson's joint report on *The Ice Age in India and Associated Human Cultures* (de Terra and Paterson, 1939).

age, as discussed on page 340. These artifacts consist of large, crude, heavily worn flakes (fig. 24; fig. 27, nos. 1–4), and the degree of rolling indicates that they were made while the Boulder Conglomerate was still in the process of deposition. These flakes, which are massive and thick, are made of quartzite, and they exhibit large, plain striking platforms that form a high angle (100° to 125°) with the long axis of the implement.

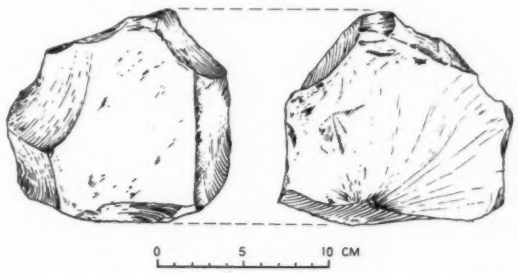


FIG. 24. Large crude ("Pre-Soan") flake from the Boulder Conglomerate at Kallar. (After de Terra and Paterson.)

Although the bulbs are flat in most examples, the cones of percussion are usually very large. With the exception of one or two small irregular scars, the upper surface is unflaked, and it frequently retains a large area of the original crust, or cortex, of the pebble or small boulder from which it was detached. One specimen was noted that had been reworked at a later date, but otherwise secondary working is absent. Since the edges are so badly battered and rolled, it is difficult to determine in all instances whether the edge chipping has been caused by human or natural agencies. None of the cores or nuclei from which these flakes were detached have yet been found. These very generalized and crude flake implements have been referred to as the "Pre-Soan" Industry, but it appears that in this instance Dr. de Terra has used the term *Soan* in a purely chronological sense, rather than to designate an early stage of the true Soan development. For, although the so-called "Pre-Soan" flakes from the Boulder Conglomerate (Second Glacial Stage) are stratigraphically older than the Early Soan proper of T_1, it has not been demonstrated as yet that they are related to the Soan cultural development, which begins in Second Interglacial times. It is therefore proposed to refer to this industry as the *Punjab Flake Industry*, since far too little is known about it at present to consider it a culture. Punjab, or "Pre-Soan," type flakes have been found at ten localities [7] in Northwestern India.

EARLY SOAN CULTURE

The evidence obtained at a total of ten sites in the Indus (from Attock to the confluence with the Soan) and Soan Valleys conclusively proves that the Early Soan culture belongs in the Second Interglacial Stage in Northwestern India. In all cases the pebble and flake implements referable to the Early Soan are found in association with deposits of T_1, on the surface of the Boulder Conglomerate (Second Glacial Stage), and heavily rolled and obviously derived in the Basal Gravels of T_2, which were laid down during the Third Glacial advance. A detailed study of the material has convinced Dr. Paterson that three groups can be recognized on the basis of patination and degree of wear. Patersons' three-fold group is as follows: *Group A*—heavily patinated and thoroughly worn; *Group B*—deeply patinated like A, but unworn; and *Group C*—less patinated and comparatively fresh. Although there is no stratigraphical confirmation for these groups, they seem to be substantiated by typology, especially that of the associated flake implements and cores. In general, the oldest tools are massive and crude; later they become progressively finer, and the accompanying "Clacton-like" flakes approach more highly evolved "Proto-Levalloisian" forms. Throughout the pebble tools (compare fig. 25), which are all hand implements apparently intended for cutting, chopping, and scraping, are made on thoroughly rounded, water-worn pebbles that are usually of flattish oval, elongated oval, or circular shape. The flaking in most cases is characterized by large and fairly regular but rather deep scars, and it extends generally along one edge of the tool in such a way as to produce a scalloped outline. In all cases, the unflaked surfaces of the artifacts exhibit the original crust of the pebble. It is to be regretted that no figures are available showing the relative frequency of the main categories of implements, as in the cases of the collections from the Lower Palaeolithic sites at Patjitan in Java and in the Irrawaddy Valley of Upper Burma, since these would be interesting for comparative purposes.

CHOPPERS

These implements, which Dr. Paterson calls "flat-based pebble tools" and "rounded pebble tools," are very characteristic of the Early Soan culture. Of the former category, the flat or nearly flat under surface of the artifacts (fig. 25, nos. 1, 3, 6, 8, and 12) is either the result of natural cleavage or of artificial breaking. From this plane, flakes have been struck upward in such a manner as to form a thick, steep cutting edge, which makes an angle varying between 50° and 80° with the base of the tool. The cutting edge itself, along which small chips have been detached as the result of use, is normally convex (fig. 25, nos. 1, 3, and 8). In some cases, however, it is fairly straight (fig. 25, no. 6), in others it may be pointed (fig. 25, no. 12), but no concave examples were found. A few of the specimens which exhibit sharp, fresh, and unchipped edges, may be cores or simply unused implements from a workshop. Although most of the tools in this category are "end" implements, the secondary working may be continued along either one or both sides to form single or

[7] See Movius, 1944: 25, and map on p. 15 (fig. 2).

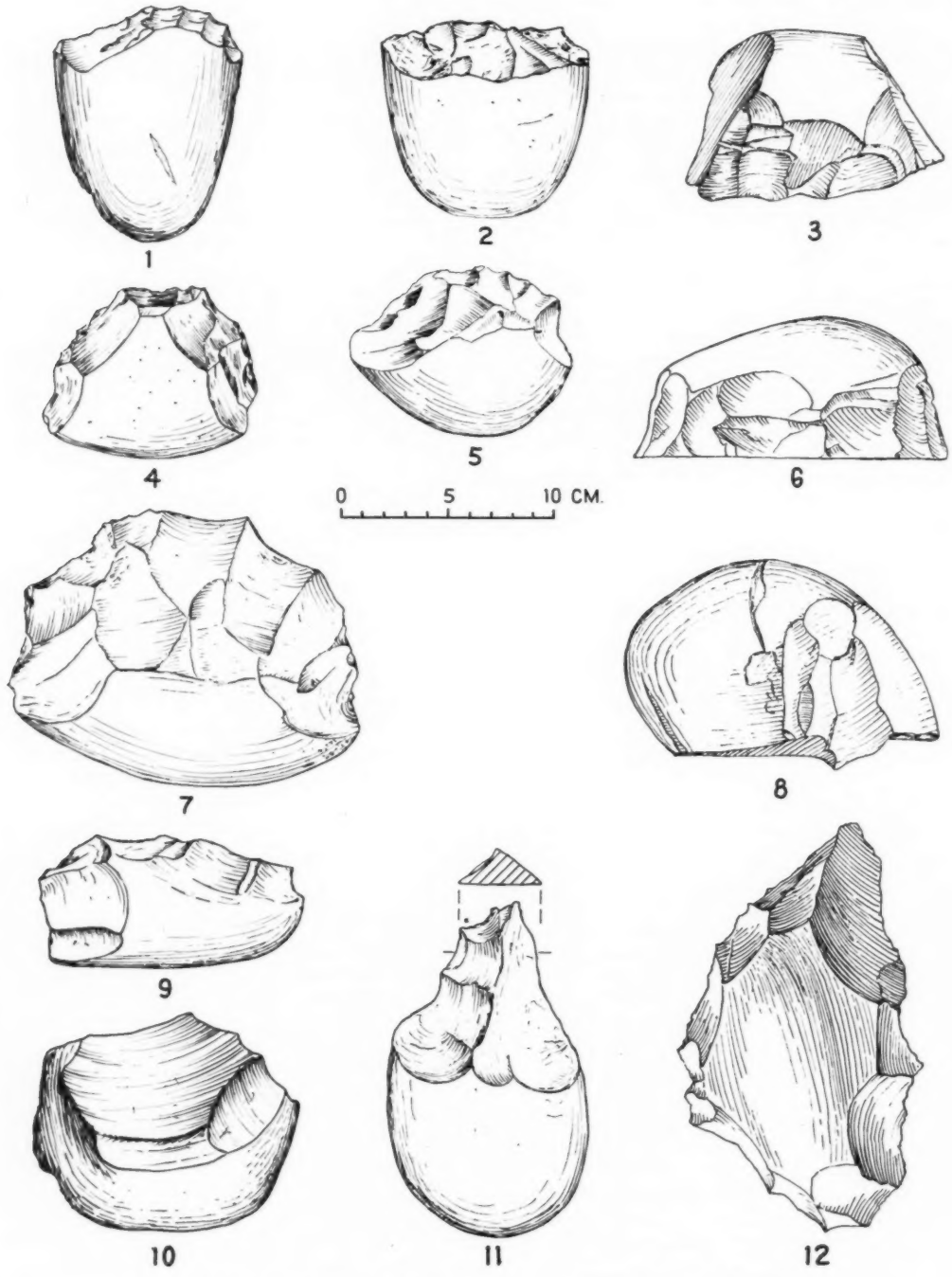


FIG. 25. Early Soan choppers and chopping-tools. (After de Terra and Paterson.)

double side choppers as well. In general, these flat-based pebble-choppers are thicker and exhibit steeper cutting edges than any of the other Early Soan implements.

The "rounded pebble tools," which include some true chopping-tools with alternately flaked edges, differ from the flat-based examples in that the flakes have been struck from the original surface of the pebble, rather than from a flat or nearly flat platform (fig. 25, nos. 2, 4, 5, 7, and 11). As in the case of the flat-based pebble tool category, however, the cutting edge is worked on one side only by the removal of a series of flakes that have left concave scars. This has produced an edge which is scalloped in appearance. The choppers made on rounded pebbles are actually thinner than the others, and the edges, which are at an angle of between 20° and 65°, are not as steep. In a few cases the opposite end has been worked as well to form an inverse, double-ended chopper, since the flaking of this second edge is from the upper surface towards the base of the tool. Such implements with a rough parallelogram-shaped section are also found in the Early Anyathian of Burma, as stated on page 368 (compare fig. 19, no. 1). The most highly evolved types of Early Soan pebble choppers are (*a*) tools on which the flaking extends all around the periphery, and (*b*) tools flaked on the upper surface only along opposite sides to fashion a pointed implement, recalling proto-hand-axe types from Patjitan in Java (see p. 356, and fig. 11, nos. 2 and 3; fig. 14, no. 4).

CHOPPING-TOOLS

True chopping-tools with alternately flaked edges (fig. 25, no. 10) also occur in the Early Soan, as stated above. These are included by Paterson in his type *b*(*i*), described as "small spheroid pebbles with a working edge formed by the intersection of two or three large flake scars struck alternately from each side, the second flake being struck from the platform formed by the first scar." [8] In Group *C* of the Early Soan, type *b*(v), common in the Late Soan, appears. It is a side chopping-tool, also with an alternately flaked edge, and made on a pebble. Paterson's type *b*(*iii*), a third characteristic type of chopping-tool (fig. 25, no. 9), is described as an implement in the manufacture of which "a flat, elongated-oval pebble is broken along its axis, and the broken side chipped to an edge by flakes struck from each surface." [9] As the result of the method of manufacture, these implements display wavy or sinuous cutting edges.

Throughout Groups *A*, *B*, and *C* of the Early Soan the same fundamental types of pebble tools are found, although admittedly there is a decided tendency to produce neater and finer implements. In any case, as far as the core-tool element in the Early Soan is concerned, the most characteristic implements consist of choppers and chopping-tools manufactured on pebbles.

FLAKE IMPLEMENTS

In comparison with the core tools, the trend towards better made implements is far more apparent in the case of the flakes, when the assemblages assigned to the several groups are examined. No flakes referable to Group *A* were found, but there is an interesting series present in Group *B* (fig. 26, nos. 1–5). All of these exhibit plain unfaceted striking platforms, which form an angle varying between 95° and 100° with the long axis of the artifact. Although retouched forms are rare, edge chipping as the result of use is common. The primary flaking on the upper surface is of such elementary character that often a portion of the original cortex of the pebble remains. "The general impression is that this industry, apart from the great number of pebble tools, has resemblances to the Early Clactonian of Europe." [10] Similar flakes with plain, rather high-angled striking platforms also occur in Group *C* (fig. 26, nos. 6 and 8), but they are flatter and better made. In addition, they exhibit more extensive primary flaking; in other words, the core preparation has been more carefully executed prior to detachment. There are also a few flakes made by a different technique. These have simply-faceted striking platforms at a normal angle to the long axis of the tool, which suggests a sort of "Proto-Levalloisian" tendency. No retouched forms were collected, but edge chipping as a result of use is apparent in many instances.

CORES

The leading type in the case of the Early Soan cores or nuclei is large, discoidal or elongated in shape, and with flakes struck off alternately from each surface (fig. 26, nos. 9–12). In the case of some examples only three or four such flakes have been detached, but for the most part the flaking extends fairly well around the sides. Apparently it was from these roughly discoidal cores, which are large and crude in Group *A*, but become progressively more highly developed in Groups *B* and *C*, that the so-called "Clacton-like" flakes, described above, were detached. A second type of core with cortex on the under surface (fig. 26, no. 7) appears in Group *C*. This is more definitely of the well-known, tortoise type, which invariably is found in association with flakes exhibiting the classic "Levalloisian" technique. These examples, referable to Group *C* of the Early Soan, are flat and have simply prepared striking platforms at either end, formed by the removal of two or three small flakes. In the final phase of the Early Soan, therefore, two types of cores exist which apparently correspond with the two types of flakes that characterize Group *C*.

[8] Paterson, with de Terra, 1939: 306.
[9] Paterson, *loc. cit.*
[10] Paterson, with de Terra, 1939: 307.

XUM

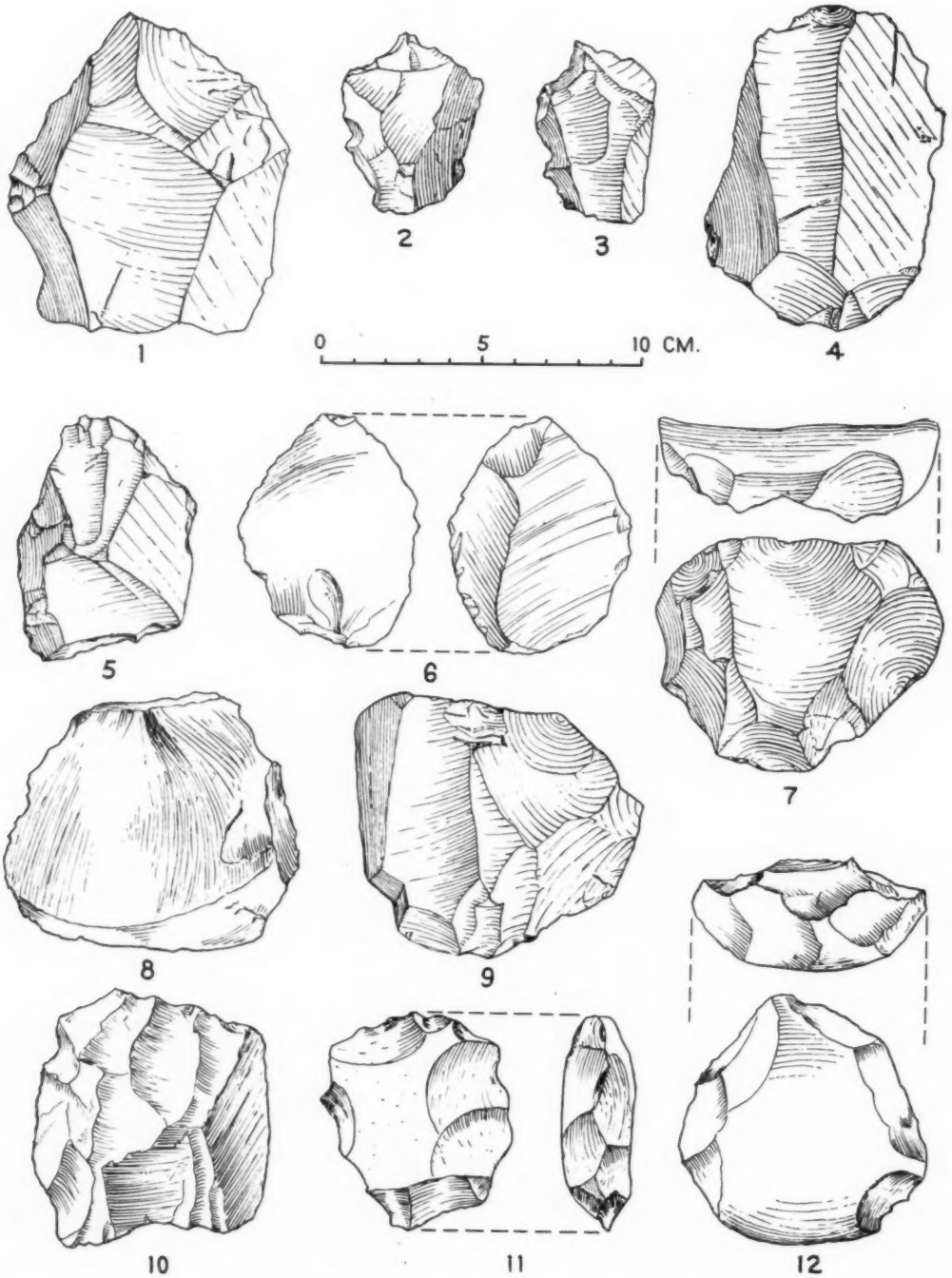


FIG. 26. Early Soan flakes and cores. (After de Terra and Paterson.)

EVIDENCE OF ABBEVILLEO-ACHEULIAN INFLUENCE

In addition to the Early Soan pebble chopper and chopping-tool culture, a typical Lower Palaeolithic hand-axe complex appears in the Potwar Region of the Punjab during the Second Interglacial Stage—the long erosion interval when T_1 was formed. This is demonstrated by the evidence from four sites in the Soan Valley, as follows: (*a*) at Section 5, southeast of Rawalpindi, some heavily rolled bifaces of Middle Acheulian type (fig. 27, no. 10) were found in a gravel deposit that was correlated with T_1 by Dr. de Terra; (*b*) at Site P. 16 at Chauntra (see below), crude and heavily rolled Abbevillian forms occur together with fresh Late Acheulian types of tools in deposits of T_2 (Third Glacial) age; (*c*) at the Late Soan work-shop of Adial: Locality 1, rolled Early Soan tools associated with an Abbevillian hand-axe were discovered on the surface; and (*d*) in the vicinity of Balawal, near Chakri: Locality 3, a water-worn Acheulian hand-axe, probably derived from deposits of T_1 age, was found in the gravels of T_2. Furthermore, at one site in the Indus Valley—Gariala, southeast of Attock—a very rolled cleaver of Early Acheulean form was found in the gravels of T_2. In general, the Abbevillian types of hand-axes are always more heavily rolled than are the Early to Middle Acheulian examples. The most primitive group includes heavy, massive, and crudely worked bifaces; they exhibit thick pebble butts, and large, steep flake scars that are markedly concave. These are associated with a few rolled flakes which have plain striking platforms and display very primitive primary flaking. From the point of view of the technique, the latter are very reminiscent of forms from the Boulder Conglomerate referable to the Punjab Flake Industry. The more developed types of hand-axes, which may be compared with Acheulian examples, reveal flatter and more carefully executed flaking (fig. 27, no. 11). For the most part their outline is regular, the cortex has been completely removed from the butt, and there is a tendency towards fairly long, narrow forms with one end slightly pointed, although ovate and cordate types are also present. Associated with these, there are a few rolled cleavers of primitive type, some roughly discoidal cores, and an occasional crudely retouched flake with a plain striking platform. In general, the typology of these tools is similar to that found in a normal Lower Palaeolithic hand-axe series of the Madrasian culture of Peninsular India.[11] In order to understand properly the relationship between the hand-axe complex on the one hand and the Early Soan chopper—chopping-tool culture on the other, in the Punjab, the evidence from Site P. 16 at Chauntra, where both cultures were found in direct association with one another, must be considered in some detail.

[11] Compare: Aiyappan and Manley, 1942; Brown, 1917; Cammiade and Burkitt, 1930; Deraniyagala, 1943: 99; de Terra, with Paterson, 1939: 313–326; Foote, 1916; Krishnaswami, 1938*a*; 1938*b*; 1947: 26–35; Manley, 1940; 1945; Menghin, 1931: 119; Misra, 1939; Mitra, 1927, chap. V; Paterson, with de Terra, 1939: 327–330; Paterson, 1941: 397–399; Richards, Cammiade, and Burkitt, 1932; Sankalia, 1946; Todd, 1932; 1939.

SITE P. 16 AT CHAUNTRA

In many respects this is the most important archaeological locality discovered thus far in the Soan Valley. Although the precise dating of the deposits in which the implements occur cannot be definitely established on the basis of the geological evidence, a careful evaluation of the available data makes it seem very likely that the oldest material is of T_1 (Second Interglacial) age, which is also the conclusion arrived at by Drs. de Terra and Paterson. At Chauntra the high terrace was denuded during Third Glacial times, and its contained artifacts were incorporated in the T_2 gravels. The implements consist of a mixture of hand-axe and chopping-tool elements, which have been divided into three groups by Dr. Paterson on the basis of their state of preservation. This three-fold division is confirmed by the typology of the tools themselves, and they may be summarized as follows:

(*a*) *Oldest Group*—These very rolled and heavily patinated implements include hand-axes of primitive Abbevillian type, some large pebble cores, and a few crude flakes. One or two of the latter exhibit very large, high-angle striking platforms, like those from the Boulder Conglomerate.

(*b*) *Middle Group*—This group is comprised of hand-axes which are less worn, better and more carefully flaked, and of more regular outline (fig. 27, nos. 5, 6, and 8). They recall Early to Middle Acheulian types.

(*c*) *Youngest Group*—The youngest material, which is fresh and unworn, is made up of well flaked Late Acheulian types of hand-axes—cordate, pyriform, and pointed ovate specimens (fig. 27, nos. 7 and 9; fig. 28, nos. 5 and 6). Also present are very characteristic Late Soan cores (fig. 28, no. 3), several flakes with faceted striking platforms (fig. 28, nos. 1 and 2) and one blade (fig. 28, no. 4).

From a typological point of view, the hand-axes from Chauntra and other sites in the Punjab are similar to examples from the rich terrace deposits in the Madras region of Southern India. As far as the Soan Valley is concerned, however, Site P. 16 at Chauntra demonstrates that in this area the Early Soan culture and the Abbevilleo-Acheulian complex developed independently, although in a parallel manner, until Late Soan times, since it is only in the youngest group of the material from the Chauntra locality that both Soan and Acheulian elements are present. This agrees fairly well with the indirect evidence based on the typology of the flake implements and cores assigned to Group *C* of the Early Soan. These reveal a marked tendency towards the

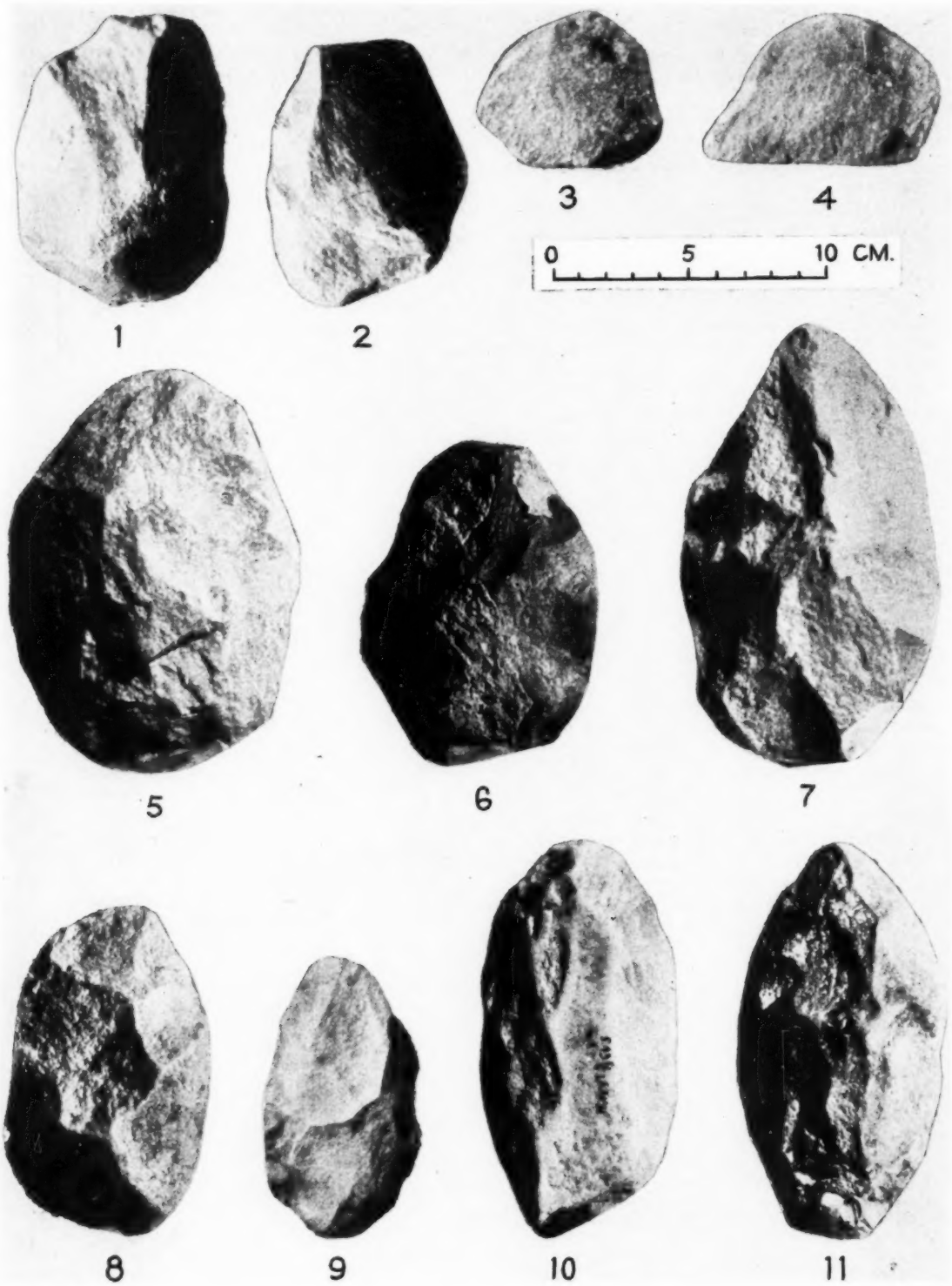


FIG. 27. Lower Palaeolithic implements from Northwest India. Nos. 1–4. Large crude ("Pre-Soan") flakes. Nos. 5–11. Abbevilleo-Acheulean hand-axes—Nos. 5–9: Chauntra; Nos. 10–11: T_1. (After de Terra and Paterson.)

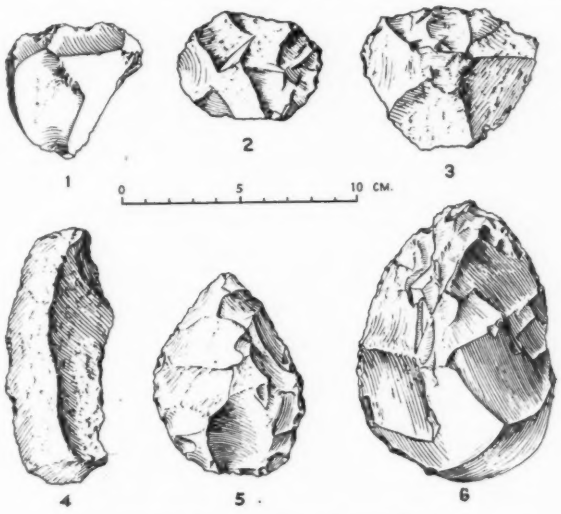


FIG. 28. Various types of Lower Palaeolithic implements from Chauntra. (After de Terra and Paterson.)

development of true "Levalloisian" types, and in the Madras area the latter are in strong evidence in those horizons which contain hand-axes of advanced (Acheulian) form.

LATE SOAN CULTURE

In the Late Soan culture the result of contacts between the Soan complex as a whole on the one hand, and the hand-axe—"Levallois" flake tradition on the other is at once apparent when the salient features of the ultural developments that occurred in the Potwar Region of the Punjab during Upper Pleistocene times are examined. On the whole, the Late Soan reveals a similar flaking technique to that found in the Early Soan, especially when compared with a Group *C* series, together with the continued use of pebble tools of the chopper variety. In the Late Soan, which is summarized below, there are two phases—*A* and *B*—based on the stratified deposits found on T_2.

LATE SOAN A

Phase *A* of the Late Soan occurs in the Potwar Basal Gravels—Third Glacial Stage—of T_2 of the Punjab sequence. It includes a large variety of chopping and scraping types of implements made on pebbles (fig. 29, nos. 3 and 4), which are on the whole smaller and better made than are those of the Early Soan, but definitely developed from them. Numerically these comprise only a small group, however, and they are associated with a far greater number of flake implements and cores. In this horizon, the "Proto-Levalloisian" types of flake tools become more distinctly "Levalloisian" in character (fig. 29, nos. 1 and 8); in fact even the so-called "policeman's hat" type of faceted striking platform (e.g., fig. 29, no. 1) occurs. The skillful flaking on the upper surface of these artifacts reveals that they were struck from carefully prepared cores of the tortoise type. These multi-faceted flakes are associated with simpler "Clacton-like" examples (fig. 29, nos. 2, 6, 7, and 9), displaying plain, high-angled striking platforms, which still comprise the majority of the flake tools. Associated with each of these flake assemblages there is a corresponding series of cores (fig. 29, nos. 10–13). In addition to the above, a few parallel-sided and elongated flakes, or true blades (fig. 29, no. 5) appear in Phase *A* of the Late Soan.

LATE SOAN B

This phase of the Late Soan culture occurs in the basal portion of the Potwar Loessic Silt on T_2 (late Third Glacial or ? Third Interglacial Stage), and the tools from this horizon are found in remarkably fresh condition. Although some pebble choppers are present, this assemblage consists in the main of flakes and blades (fig. 30, nos. 1–4, 6, and 7), which are associated with various types of cores. Approximately 50 per cent of the flake artifacts display faceted striking platforms (e.g., fig. 30, no. 1), and from the upper surface of the tool, large primary, core-trimming flakes have been removed prior to detachment. No retouched specimens have been recorded, although edge-chipping resulting from use is apparent in some instances. The cores (fig. 30, no. 5) are basically the same as those found at the Late Soan *A* sites. With the exception of the pebble tools, this phase of the Late Soan presents very close typological parallels with the Late Levalloisian of Western Europe.

The Late Soan culture is very widespread in the Punjab, where it has been recorded at a total of 21 sites.[12] In addition, a site near Pindi Gheb, which is probably of Fourth Glacial age, has yielded a local industry of very specialized Soan facies.[13] Chronologically this appears to be the youngest manifestation of the Soan culture yet recorded in Northwestern India, a fact which is substantiated by the highly evolved character of the implements.

SUMMARY AND CONCLUSIONS

In general, the archaeological sequence in the Punjab reveals that the earliest tools, large massive flakes with little retouch and referable to the Punjab (or "Pre-Soan") Flake Industry, occur in the upper portion of the Boulder Conglomerate. Stratigraphically, therefore, these are of Second Glacial age. During Second Interglacial times the Early Soan culture, which consists of pebble chopper, chopping-tools, and flake implements, appears. Apparently in part contemporary with this manifestation of a fundamentally "Eastern"

[12] de Terra, with Paterson, 1939: 276–298; Sen, 1938; listed in Movius, 1944: 28.

[13] de Terra and Paterson, 1939: 293, 310–311, and pl. XLIV.

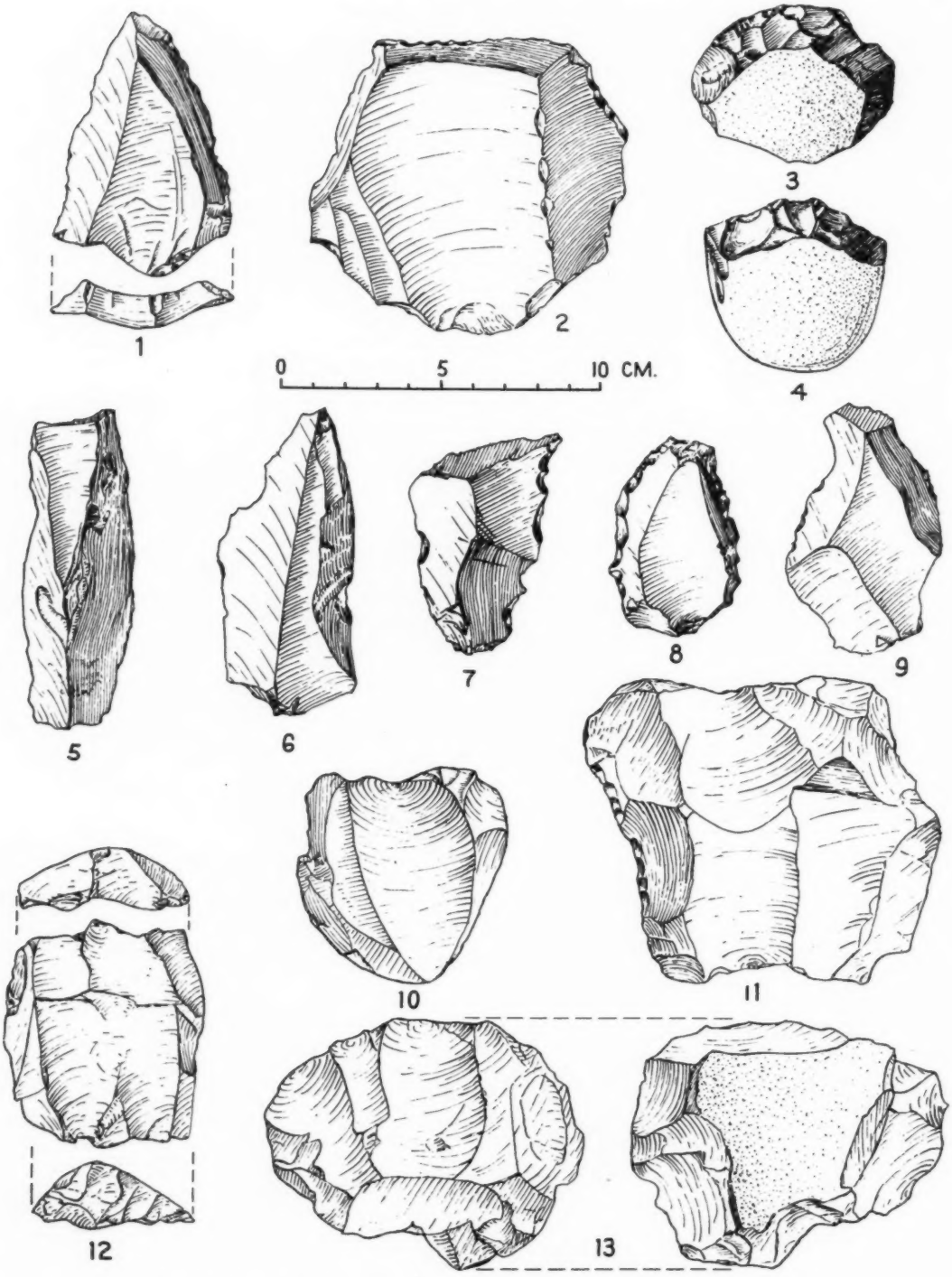


FIG. 29. Late Soan A choppers, flakes, and cores. (After de Terra and Paterson.)

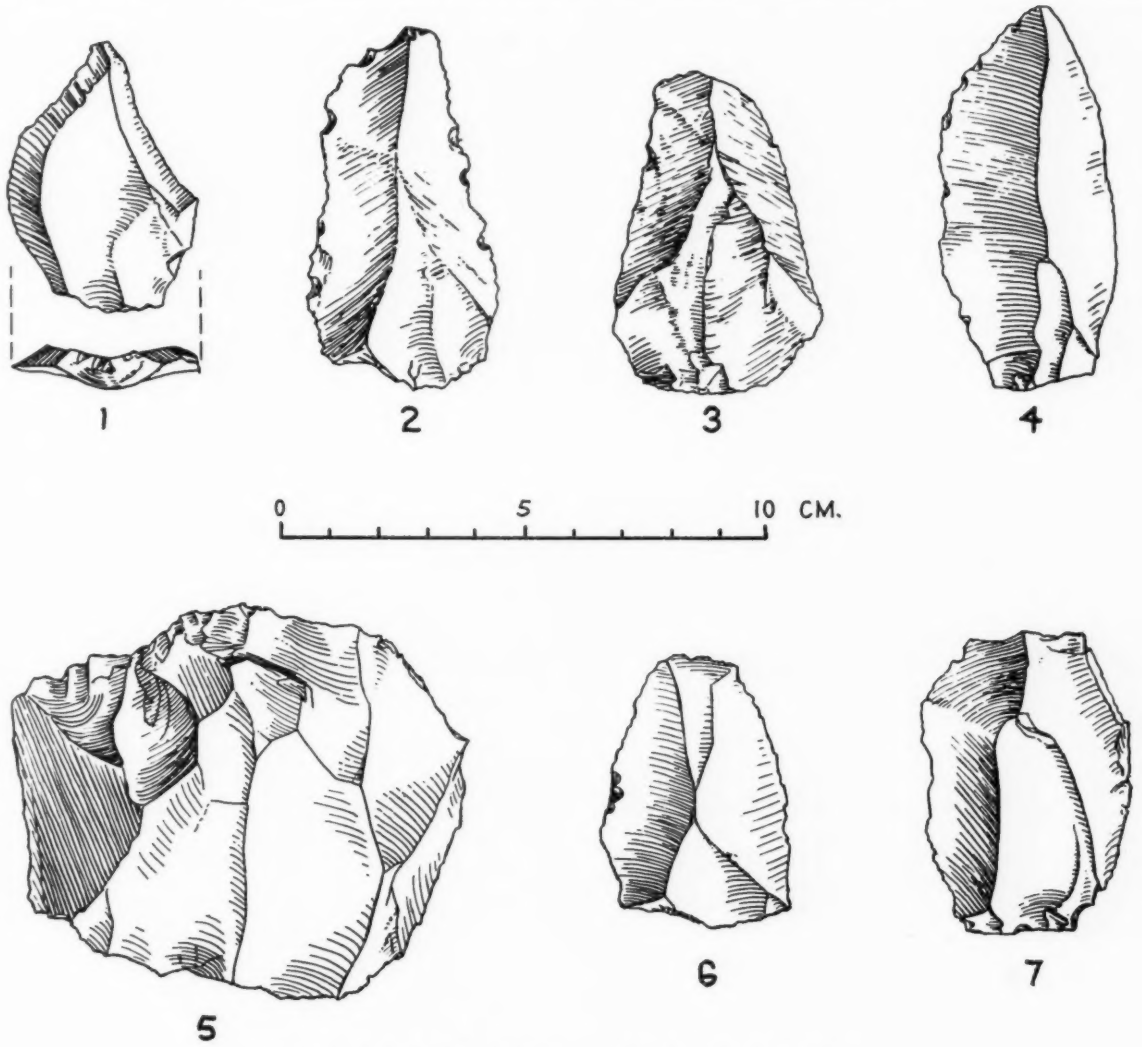


FIG. 30. Late Soan B implements. (After de Terra and Paterson.)

culture-complex is a series of hand-axes suggesting the same Abbevillian and Acheulian affinities as those from the classic sites of the Madras region farther south. The evidence from the site at Chauntra indicates that these two basically divergent cultural traditions developed more or less independently until Third Glacial times. For the one has definite affinities with the Far East—Northern China, and Upper Burma, and Java—while the other belongs to a great complex found in Peninsular India, the Near East, Europe, and Africa. As far as the Early Soan of the Punjab is concerned, however, the pebble tools are at first massive and crude, but become progressively finer, while the associated flakes, which are in the main "Clacton-like" from a typological point of view, approach so-called "Proto-Levalloisian" forms in the later stages of the culture. These latter flake tools of Group *C* of the Early Soan seem to herald the appearance in the Third Glacial (Potwar) gravels of T_3 of a flake assemblage with faceted striking platforms and of a pronounced "Levalloisian" character, together with typical tortoise-type cores. The simple "Clacton-like" flakes and cores of this Late Soan culture, as well as the small group of well-worked pebble tools which is likewise present, seem to have developed from comparable, less highly evolved forms of the Early Soan. Unfortunately to date no site has been found in this region where the stratigraphical evidence is sufficiently clear to determine which

of the two basic complexes was the earlier in the Punjab—the Abbevilleo-Acheulian hand-axes and cleavers, or the Early Soan pebble choppers and chopping-tools. Both are certainly later than the late Upper Siwalik Boulder Conglomerate and therefore of Second Interglacial age.

VII. THE SITE OF CHOUKOUTIEN AND THE CHOUKOUTIENIAN CULTURE OF NORTHERN CHINA

In China the history of the discovery of Early Man and his culture is intimately linked with the brilliant work by various members of the Geological Survey of China, and its affiliated Cenozoic Research Laboratory in Peking, on the famous site of Choukoutien. This important locality lies some 26¼ miles southwest of Peking, immediately west of the village of Chou K'ou Tien, on the border of the Hopei Plain and at the eastern margin of a deeply dissected Late Mesozoic platform that rises over 1,000 meters above sea-level, known as the Western Hills. Actually the place itself is a low hill (fig. 31, nos. 1 and 2), some 60 meters high and composed of Ordovician limestone, much of which has been removed by quarrying operations. Although the fossiliferous fissure deposits of Choukoutien, which lie at a height of some 150 meters above present sea-level, were discovered in 1918 by Dr. J. G. Andersson, it was not until eight years later that the first human remains were published—two teeth, found in 1923 by Dr. Otto Zdansky.[1] These were recovered in definite and direct association with a Pleistocene fauna. In 1927, with financial support from the Rockefeller Foundation, excavations at the site were undertaken,[2] which continued until 1937, when Peking was captured by the Japanese. On the basis of the morphological characteristics of the original teeth, as well as those of a third tooth found by Dr. B. Bohlin, Dr. Davidson Black decided in 1927 to give the human material generic status under the title of *Sinanthropus pekinensis*, or Peking Man.[3] It was not until 1929, however, that the first *Sinanthropus* skull, discovered by Dr. W. C. Pei, came to light.[4] During the subsequent seasons, an enormous wealth of anthropological and archaeological material was collected as the result of the painstaking work of the members of the Cenozoic Research Laboratory, so that today Choukoutien is recognized as one of the most important sites for students of Early Man in the Old World.

The *Sinanthropus* finds are important for two reasons. Firstly, they present the most complete record of fossil human material ever found in Middle Pleistocene deposits; and, secondly, they come from an occupation site in direct association with artifacts, hearths, and literally tons of fossil animal bones. To date *Sinanthropus* is represented by the skeletal parts of about forty-five individuals, males and females, adults and children. No single specimen is comp'ete, and a great many consist only of teeth,[5] of which some one hundred and fifty isolated examples were found. Other individuals are known from skulls (six fairly complete skulls have been discovered thus far) or lower jaws (of which a total of twelve have been unearthed), but none of them belonging to the same individuals as those represented by the skulls. Limb bones are very scarce; they consist mainly of broken femora (seven pieces) and humeri (two pieces),[6] which are essentially modern and demonstrate that *Sinanthropus* was fully erect. The bones are all fragmentary and scattered throughout the deposit from top to bottom, a fact which, together with the evidence of the skulls—the lesions and depressed fractures which many of them exhibit, as well as the destruction of the base—has led Dr. Weidenreich to the positive conclusion that *Sinanthropus* was a cannibal.[7] As to stature, *Sinanthropus* was of moderate size compared to modern man, the females being somewhat smaller (4 ft. 8½ in.) than the males (5 ft. 1½ in.),[8] as is also indicated by the differences in size of the brain-cases, teeth, and jaws. But since we are primarily concerned here with the culture of *Sinanthropus* and his geological antiquity, the anatomical peculiarities of this important early human fossil will be omitted. These, together with the evolutionary status of Peking Man, have been discussed in detail by Drs. Davidson Black and Franz Weidenreich in Series D of *Palaeontologia Sinica*.[9]

The cultural refuse from Choukoutien includes burnt animal bones, antlers, horn cores, wood fragments, and hackberry seeds, as well as enormous layers of ash indicating the presence of extensive hearths. These prove that Peking Man was familiar with the making and use of fire, not only for heating purposes and for protection from predatory animals, but also presumably for cooking. Associated with the hearths, first noted during the 1930–1931 season,[10] the occurrence of flint implements was recorded by Dr. Pei, and later in the same year confirmed by Professor Breuil.[11] As Breuil has stated, on the basis of the fact that the Choukoutien implements cannot be directly compared with the well-known European Palaeolithic types, the culture of *Sinanthro-*

[1] Andersson, 1919; Zdansky, 1926.
[2] Black, Teilhard, Young, and Pei, 1933.
[3] Bohlin, 1927; Black, 1927.
[4] Pei, 1929.
[5] Weidenreich, 1940*b*: 375; 1941: 29.
[6] In addition one broken clavicle and an isolated wrist bone (right lunate) were found.
[7] Weidenreich, 1939*b*: 49–63; 1943: 184–191; compare Hooton, 1946: 304; Howells, 1945: 149.
[8] According to Dr. Hooton (1946: 303), this means that Peking Man was about as short as the Eskimos, Ainus, and Japanese of the present day.
[9] See especially Weidenreich, 1943, which is by far the most exhaustive study of *Sinanthropus* that has yet appeared.
[10] Black, 1931.
[11] Pei, 1931*a*; Breuil, 1931, 1932*a*, 1932*b*.

1

2

3

FIG. 31. The *Sinanthropus*—Locality at Choukoutien. (1) General view of Choukoutien: Locality 1 from the North. The excavation headquarters of the Cenozoic Research Laboratory on the right; on the left the Kotzetang Cave opening into the side of the hill. (After Black, 1934.) (2) Panorama of the Coukoutien Hill from the East. In the center foreground are the *Sinanthropus*-Deposits of Locality 1. (After Black, 1934.) (3) The main fissure-deposit at Choukoutien: Locality 1, showing the excavations in progress. (After Pei, 1937*b*.)

XUM

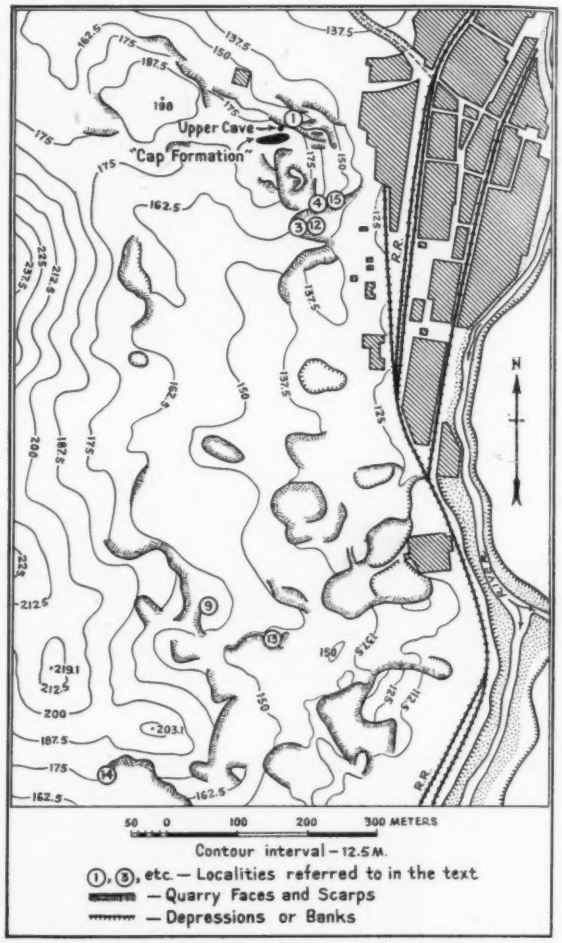
pus should be regarded as a separate development.[12] For this culture he proposed the name "Choukoutienian," a term which has been adopted by the writer.[13] As regards the geological age of the *Sinanthropus*-deposits at Choukoutien, existing data prove conclusively that this important locality, regarded by many Chinese and European scientists as belonging to the Lower Pleistocene,[14] should be assigned to the Middle Pleistocene in terms of the sequences firmly established in Northwestern India, Upper Burma, and Java, as stated on page 345. Indeed the writer agrees completely with Dr. Hopwood's conclusion that "on faunistic ground alone, therefore, these deposits in China [i.e., Choukoutien: Locality 1] may be regarded as of Middle Pleistocene age."[15] Before attempting to describe the archaeological material from the three Lower Palaeolithic occupation sites at this important locality, however, it is of obvious importance to consider briefly the Late Cenozoic physiographic history of the area with special reference to the fissure sequence at Choukoutien.

THE FISSURE SEQUENCE AT CHOUKOUTIEN

For the solution to the problem of the geological age of the numerous fossiliferous fissure deposits at Choukoutien, in terms of the established Late Cenozoic sequence in Northern China as a whole (see pp. 342–348), the palaeontological approach is obvious. On the one hand (in the case of the North China Plain), we are dealing with stratified basin deposits for the most part, whereas on the other (at Choukoutien) there are only the actual contents of the fissures themselves to rely on. Furthermore, although a total of fifteen fossiliferous localities have been excavated in the Choukoutien area (see map 3), none have been found thus far that cover more than one stage. But not all of them were laid down under identical conditions. The following synthetic statement of the Choukoutien fissure sequence is based in the main on Dr. Teilhard de Chardin's recent monograph,[16] supplemented by data obtained from other sources, as indicated in the footnotes.

Originally the numerous fossiliferous pockets, or fissures, exposed in the Ordovician limestone at Choukoutien were regarded as contemporaneous. As the work progressed, however, it gradually became clear that in reality they form a remarkable sequence, apparently ranging in time from the Miocene up through the end of the Pleistocene. This has been established both from the nature of the sediments, as well as the palaeontological evidence. On the basis of existing data, the following *eight* stages, shown in figure 32, have been distinguished in this sequence, in ascending order:

1. Water-laid yellow sands, clays, and gravels, partly consolidated, and locally containing *Cyprinidae* Fish remains. The Choukoutien Hill was completely submerged at this time, and the river was flowing some 70 meters higher with respect to its present level. Subterranean solution cavities, later filled with Pleistocene deposits, were formed at this time.[17] ..... Fish Pocket, Locality 14 MIOCENE (?)


Upper Cave
"Cap Formation"
RR
N
50 0 100 200 300 METERS
Contour interval – 12.5 M.
①, ③, etc. – Localities referred to in the text
– Quarry Faces and Scarps
– Depressions or Banks

MAP 3. The Choukoutien area. (After Teilhard and Pei, 1934.)

[12] Breuil, 1935: 744.

[13] Movius, 1944.

[14] Compare Teilhard and Young, 1929; Black, Teilhard, *et al.*, 1933; Pei, 1931*b*, 1939*a*; Lee, 1938; Teilhard, 1941; Zeuner, 1946: 271.

[15] Hopwood, 1935*a*: 55; see also Colbert, 1942: 1487; de Terra, 1941: 23; Movius, 1944: 67–68.

[16] Teilhard, 1941: 46–49. Whereas Teilhard's chronological scheme is in complete accord with that set forth by the present writer (see Movius, 1944), an important difference with regard to terminology is apparent. Thus, although Teilhard recognizes the fact that the First Glacial Stage is concomitant with the Villafranchian (see footnote 101, p. 345), he places the latter in the Upper Pliocene. It is on this basis that he relegates the *Sinanthropus*-deposits at Choukoutien to the Lower Pleistocene. His succession of sedimentary cycles, therefore, allows no interval for the Middle Pleistocene. (Compare Teilhard, 1941: 44–45; Teilhard and Pei, 1944: 10, fig. 1.)

[17] Teilhard and Young, 1929: 188; Black, Teilhard, *et al.*, 1933: 23; Teilhard and Pei, 1934: 370–374; Chang, 1936; Young, 1945: 132.

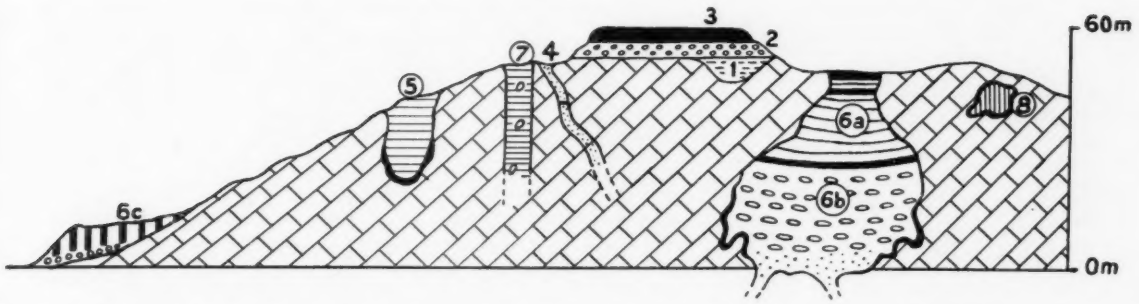


FIG. 32. Sequence of Fissure-Deposits at Choukoutien. (1) Locality 14, Fish Pocket (Yellow Sands)—Miocene(?). (2) Upper Gravel (Piedmont Deposit)—Lower Pliocene (Pontian). (3) "Cap Formation" (Travertine)—Upper Pliocene. (4) Locality 12, *Cynocephalus*-Pit (Gravels and Clays)—Lower Pleistocene (Villafranchian). (5) Locality 13 (Red Clays)—Early-Middle Pleistocene. (6) Locality 1: *Sinanthropus*-Deposits: (*a*) Upper Zone (Ashes and Clay); (*b*) Lower Zone (Sands and Breccias)—Late-Middle Pleistocene. (6*c*). Terrace at a height of 20 meters above the stream. This probably corresponds in age with the *Sinanthropus*-Deposits. (7) Locality 15 (Reddish to Yellowish Loams)—Early-Upper Pleistocene. (8) Upper Cave (Yellow Loam)—Late-Upper Pleistocene.

With the exception of Locality 13 (No. 5 in the above sequence), which lies one kilometer south of Locality 1, all the deposits shown above actually occur as represented on the same Ordovician limestone hill, 60 meters high, at Choukoutien. Stalagmitic layers or incrustations are indicated by solid black horizontal lines or irregular contours. Numbers in circles indicate localities occupied by Man. (After Teilhard, 1941—very slightly modified.)

2. Thick, loosely cemented, conglomerate, consisting of well-rounded, more or less weathered, pebbles and boulders. These gravels represent the irregular filling of underground fissures laid down on the limestone floor, first by a lake, and later as a fan deposit. They are definitely not the remains of a well-levelled sub-aerial formation ....Upper Gravel
LOWER PLIOCENE
(Pontian)

3. Hard fossiliferous travertine (cave stalagmitic deposit), at 170 meters above present sea-level, containing *Prosiphneus, Hipparion, Nemorhaedus*-like Antelope, a large Viverrid, etc. This fauna is older than the Villafranchian and younger than the Pontian.[18] ....."Cap Formation"
UPPER PLIOCENE

4. Fossiliferous rusty gravels and red clays filling a system of dissolution pits. These deposits yield a fauna which is definitely younger than that of the "Cap Formation"; it contains many typically Villafranchian forms. The rolled condition of the gravels and the fossil bones indicates an accumulation under conditions of flowing water, demonstrating that the hill had still only partially emerged.[19] .....*Cynocephalus*—Pit
Locality 12
LOWER PLEISTOCENE
(Villafranchian)

5. Highly fossiliferous, homogeneous, sub-aerial red clays in broad and shallow fissures, containing *Siphneus epitingi, Machairodus ultimus, Hystrix laregelii, Elephas* sp., *Eurycceros* (*Sinomegaceros*) *flabellatus*, etc. With the exception of the basal portions of several of the deepest fissures, the Choukoutien Hill had completely emerged by this stage, and the river was flowing at or near its present level. Evidence of human occupation at Choukoutien: Locality 13.[20] .....
Localities 9 and 13
Early portion of the
MIDDLE PLEISTOCENE

6. *Sinanthropus*-deposits, most probably laid down in a gradually expanding and collapsing cave (see figs. 31 and 34). These sediments may be divided into two major zones:
(*a*) Upper ashes and travertine (Zone I) containing *Hyaena ultima.*
(*b*) Lower sands and breccias (Zone II) containing *Hyaena sinensis.*

Both zones are highly fossiliferous: *Siphneus wongi, Machairodus inexpectatus, Eurycceros pachyosteus, Pseudaxis, Bubalus teilhardi, Rhinoceros mercki*, and *tichorhinus, Ursus spelaeus, Felis youngi*, etc. The faunistic evidence demonstrates a milder and damper climate than the present one.[21] .....Locality 1
Late portion of the
MIDDLE PLEISTOCENE

N.B. With the *Sinanthropus* fissure deposits the red sands and silts with basal gravel, forming a 20-meter terrace along the present Choukoutien River (6*c*), should be correlated, according to Dr. Teilhard.[22]

7. Fossiliferous reddish loams containing angular limestone fragments overlain by yellowish loam, full of white calcified tubes and worm-like concretions. Fauna includes *Eurycceros* (Evolved form), *Equus hemionus, Rhinoceros tichorhinus, Gazella prjewalskyi, Cervus canadensis, Siphneus* cf. *wongi*, Jerboa and Ostrich. The character of these sediments, together with the evidence of the fauna, indicates deposition under the cool, semi-arid conditions of a continental Glacial

[18] Pei, 1939*d*: 214–223.

[19] Teilhard and Pei, 1934: 374–378; Teilhard, 1938*b*; Pei, 1939*d*: 208–214. Locality 18, which lies near the village of Huaiyü, in the Hunho Valley, some 28 miles north of Choukoutien, also contains a Villafranchian-type fauna (compare Teilhard, 1940; 1941: 14). To this same stage a series of gravel formations at varying heights above the Hopei Plain, described by Young and Bien (1936), have been assigned. At present there is no evidence that Northern China was occupied by Man during Lower Pleistocene times.

[20] Teilhard and Pei, 1934: 378–382; 1941; Teilhard, 1936; Pei, 1934*a*; 1937*a*: 224; 1939*a*: 6; Young, 1937: 282–283.

[21] Li, 1927; Teilhard and Young, 1929; Teilhard and Pei, 1932, 1934: 382–383; Black, Teilhard, *et al.*, 1933; Black, 1934: 109; Teilhard, 1935; 1941: 57–62; Pei, 1937*b*, 1939*d*: 225–230; Weidenreich, 1941.

[22] Teilhard, 1941: 49.

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Stage. Evidence of human occupation at Choukoutien: Locality 15.[23]	Locality 15 Early portion of the UPPER PLEISTOCENE
8. Yellow, scarcely consolidated, calcareous loam containing *Siphneus armandi, Hyaena ultima* (*spelaea*), *Ursus spelaeus* (rare), *Cervus elephus, Cynailurus, Paguma larvata, Struthio, Homo sapiens,* etc. Archaeological material of highly evolved Upper Palaeolithic type.[24] ..	Upper Cave Latest portion of the UPPER PLEISTOCENE (or ? Early Post Pleistocene)

The eight stages outlined above clearly reveal a gradual uplifting of the Choukoutien area, as pointed out by Dr. Teilhard.[25] First covered by relatively deep water (Fish Pocket), and later by piedmont deposits (Upper Gravel), the region had only partly emerged by the time the "Cap Formation" was formed, and Locality 12 (Villafranchian) was filled with gravels. As the result of the Post-Villafranchian movement (Huangshui Erosion), the emergence was almost completed, and the sediments in Localities 9 and 13 accumulated under sub-aerial conditions, with the exception of the basal portions of the deepest fissures. The climatic turning point between the Middle and the Upper Pleistocene is well marked by the nature of the loams filling Locality 15. These clearly indicate deposition under the cool, semi-arid conditions of a continental glacial climate, which judging by the evidence from contemporary formation elsewhere in Northern China (pp. 345, 348), must have been the Third Glacial Stage in terms of the Himalayan sequence. On this basis, the age of the *Sinanthropus* deposits at Locality 1 becomes somewhat more apparent.

Tentatively, the main deposits at the important Locality 1 site have been correlated with the Second Interglacial Stage of Northwestern India, as shown on the table (see p. 347). If this correlation is correct, and if the assignment of the Trinil plant bed to the Second Glacial Stage on the Asiatic mainland, as discussed on page 334, is justified, then *Pithecanthropus erectus* of Java lived somewhat earlier than the "Peking Man." This confirms the conclusion arrived at by Drs. von Koenigswald and Weidenreich that, from a morphological point of view, *Pithecanthropus erectus* is in some respects more primitive (e.g., in the smaller average size of his cranial capacity) than *Sinanthropus* (or *Pithecanthropus*) *pekinensis*.[26] In any case, in China, as in the Punjab and Upper Burma (see pp. 337 and 340), the first evidence of Man occurs in the early Middle Pleistocene—Second Glacial Stage in terms of the Himalayan succession. From this time on to the close of the Pleistocene, the archaeological record at Choukoutien is broken only by the interval covered by the Chingshui Erosion Stage (Third Interglacial), and the late Upper Pleistocene Malan Loess and associated deposits (Fourth Glacial Stage). To this latter stage belongs the Ordos culture, as revealed by the occupation sites actually in the Malan deposits and excavated by Dr. Teilhard de Chardin and Father Licent (see p. 348).[27] It is to be hoped that perhaps an as yet unexplored fissure at Choukoutien may contain human remains and implements that will fill the gap between the early Upper Pleistocene of Locality 15 (Third Glacial Stage) and the Upper Cave. Thus far, the Lower Pleistocene (Villafranchian), as well as the Middle Pleistocene, are abundantly represented from a palaeontological point of view.

THE LOWER PALAEOLITHIC OCCUPATION SITES AT CHOUKOUTIEN AND THE CHOUKOUTIENIAN CULTURE

To date human artifacts have been discovered at altogether five of the "localities" within the complex system of fossiliferous fissures at Choukoutien: Locality 13, Locality 1 (the *Sinanthropus*-site), Locality 15, Locality 4, and the so-called Upper Cave. Since the very late Upper Palaeolithic material from the Upper Cave, mentioned above, lies outside the scope of this paper, and since the artifacts from Locality 4 have not been published as yet, a discussion of the objects from these two stations is not included here. The remaining three sites—Locality 13, Locality 1, and Locality 15—will be considered in chronological order.

LOCALITY 13

At Locality 13, a small fissure 15 meters long, 6 meters wide, and over 5 meters deep (base not reached), a heavily patinated chopping-tool made of Sinian chert (fig. 33) was discovered in the so-called Upper Zone of the deposits, a stratum which consists of undisturbed sandy red clayey loam.[28] The rich fauna from this site,

[23] Teilhard, 1935; Pei, 1937*a*: 225–226; 1939*a*: 8; 1939*b*: 129; 1939*c*; de Terra, 1941: 34. Probably of this same period are two other fissures at Choukoutien—Locality 3 (Teilhard and Pei, 1934: 384–385; Pei, 1936; Young, 1935: 133) and Locality 4 (Pei, 1939*d*: 223–225). At both sites the work is still in a preliminary stage. Although the actual presence of Man is thus far undocumented at Locality 3, some artifacts have been found at Locality 4.

[24] Teilhard and Pei, 1934: 385; Teilhard, 1935; Pei, 1934*b*; 1937*a*: 228; 1939*a*: 6, 7, and 9; 1939*e*; 1939*f*; 1940*a*; Young, 1937: 283–284; Weidenreich, 1939*a*.

[25] Teilhard, 1941: 49. In this connection, it should be pointed out that according to Dr. Teilhard's diagrammatic scheme there are only *seven* stages, since the two numbered 3 and 4 above are considered together as *3a* and *3b*. For the sake of clarity, however, they are shown here as separate.

[26] von Koenigswald and Weidenreich, 1939: 926.

Professors Zuckerman (1933; 1940), Le Gros Clark (1937; 1945: 2), Simpson (1945: 68 and 188), and Ruggles Gates (1944: 279) apply the generic term *Pithecanthropus* to the Chinese as well as to the Javanese fossils. These authorities all agree that, according to the rules of biological nomenclature, *Sinanthropus pekinensis* should now become *Pithecanthropus pekinensis*.

[27] Teilhard and Licent, 1924*b*.

[28] Pei, 1934*a*; see also Teilhard, 1935: 737.

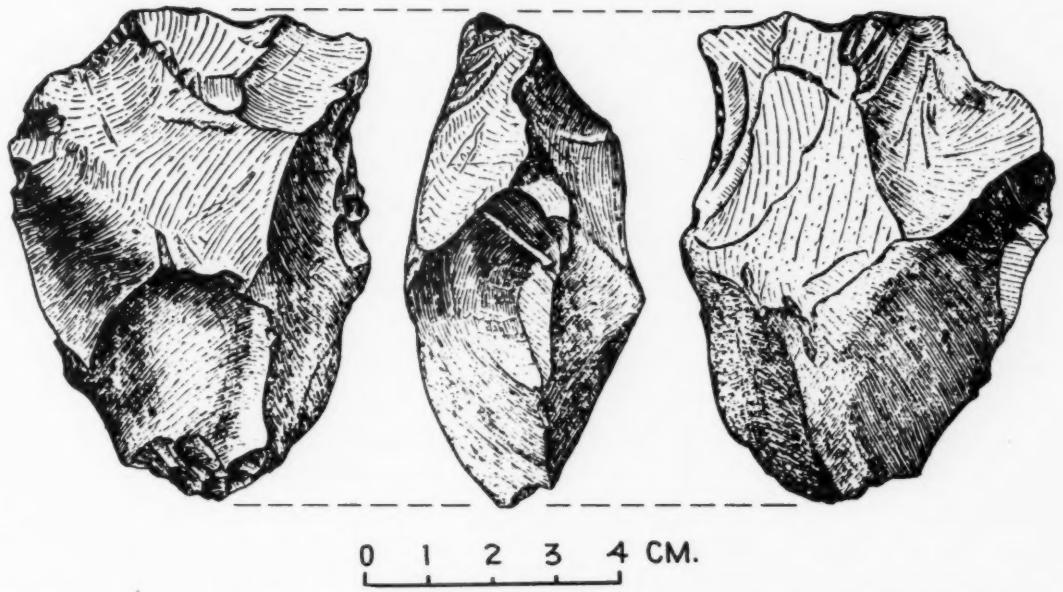

FIG. 33. Small chopping-tool from Choukoutien: Locality 13. (Courtesy of the Cenozoic Research Laboratory of China.)

situated 1 kilometer south of Locality 1 (see map 3), definitely represents a typical early Middle Pleistocene assemblage of Upper Sanmenian type. The implement came from a depth of some 4.00 meters; it was found in association with a few burnt bones and "some broken foreign stones on which the artificial working is not apparent." [29] The character of the Upper Zone deposits at this site clearly indicates, according to the excavators, that these sediments were laid down in the open after the roof of the formerly-existing cave had collapsed. In any case, the extensive ash layers containing hearths found at the *Sinanthropus*-locality were absent, although a few traces of charcoal were found. This evidence demonstrates that Locality 13 was not regularly occupied.

Originally the Locality 13 implement was described as a rough "biface," flaked in a manner recalling the Abbevillian technique of Western Europe.[30] Recently, however, Dr. Teilhard has described it as a "chopper of a decidedly 'Soan type.'" [31] Although the writer has not seen the original specimen, the excellent cast in the collection of the Peabody Museum of Harvard University certainly substantiates Teilhard's conclusion.[32] There is no question that this object is a small chopping-tool made on a pebble, and that it has been manufactured by the well-known technique of alternate flaking. It is more or less oval in shape with a beaked projection at one end; the actual measurements are 7.85 cm. long, 5.8 cm. broad, and 3.63 cm. thick. This human artifact is of great importance, because it is the earliest evidence of Man thus far brought to light in China. The deposits in which it was found very probably may be equated with the Second Himalayan Glaciation, since they occupy an analogous stratigraphic position in the Pleistocene sequence of the Far East in terms of this event (compare table 1, pp. 346–347). In any case, the palaeontological evidence shows that the Locality 13 deposits are concomitant with the cycle of deposition which immediately followed the Huangshui Erosion Stage, when the modern drainage system was established in the Huangho Basin.

LOCALITY 1—THE *SINANTHROPUS* LOCALITY

A rich fauna, very typical of the Middle Pleistocene of Northern China, is found in direct association with *Sinanthropus pekinensis* at Choukoutien: Locality 1. The deposits at this important site, although they have been discussed on numerous occasions by various authorities,[33] have never been adequately described, since no comprehensive excavation report on the place as a whole has yet appeared. At the time of occupation, it seems evident that Locality 1, situated on the axis of a limestone anticline, was a cave facing roughly northeastward (map 3) rather than a huge open fissure in

[29] Pei, 1937*a*: 224.

[30] Pei, 1934*a*: 367; 1937*a*: 224; 1939*a*: 8; Teilhard, 1935: 736.

[31] Teilhard, 1941: 57.

[32] Compare Movius, 1944: 71.

[33] Li, 1927; Teilhard and Young, 1929; Teilhard and Pei, 1932; 1934: 382–383; Black, Teilhard, *et al.*, 1933; Black, 1934: 109; Teilhard, 1935; 1937*c*; 1941: 57-62; Pei, 1937*b*; 1939*d*: 225–230; Weidenreich, 1941.

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the side of the Choukoutien Hill as it is at present (see fig. 31, nos. 1 and 2). In any case, this explanation is strongly suggested by the angular limestone blocks, presumably fallen from the roof, that are found, especially in the upper levels of the deposit. Indeed the evidence suggests that the cave was already completely collapsed and levelled off by the beginning of Upper Pleistocene times. The present deposit apparently results from the gradual upward and westward shifting of the occupied area within the empty portion of the cave, brought about by periodic collapses of the roof. Man seems to have resumed possession of the site following each collapse, until finally, when the roof had become increasingly thin, it subsided altogether. The site is about 175 meters long by approximately 50 meters wide (fig. 31, no. 3), and it contains a series of stratified sediments—earth, sand, and clay—that are over 50 meters thick. Thus far only about one-half of the extensive deposits have been excavated. Although some 30 individual strata have been distinguished from top to bottom, only two main stages of filling, shown on the section (fig. 34), are at present recognized:[34]

ZONE I (*Hyaena ultima* zone)—This consists of extensive ash layers or hearths terminating above in a succession of stalagmitic layers and red concretionary clays, containing much angular limestone debris, fossilized bones of Man, and an extinct fauna, as well as stone artifacts.

ZONE II (*Hyaena sinensis* zone)—The lower zone is composed of banded yellow, red, or black sandy clays and some angular limestone debris, coarser and more heavily brecciated than the material of the upper zone, and associated with a large series of implements, fossil animal bones (including Man), and other cultural debris. The so-called Lower Fissure (see fig. 34), which is included in this zone, is filled down to bedrock with sands and loams cemented together by the secondary infiltration of calcium in solution; it yields *Sinanthropus* remains, as well as archaeological and palaeontological material.

In spite of the fact that these two main stages exist, it is generally accepted that the deposits of Locality 1 are homogeneous, and that they were laid down during one continuous cycle of deposition. This is confirmed not only by the consistent nature of the fauna found throughout, but also by the fact that from top to bottom there is no apparent change in the *Sinanthropus* material from a morphological point of view.

The intimate association between the human fossils found at Locality 1 on the one hand, and the extensive hearths, quantities of implements, and enormous numbers of bones of extinct, edible species of animals on the other, leads to the positive conclusion that the site was occupied by men of the *Sinanthropus* race during Middle Pleistocene times, and that these men were responsible for the Choukoutienian culture.[35] That *Sinanthropus* was a great Deer hunter is indicated by the evidence of the bones—almost 70 per cent of those from the site belong either to *Euryceros pachyosteus* (a curious Fallow Deer with extremely flattened antlers and thickened skull and jaw) or to *Pseudaxis grayi* (a Sika-type of Deer). But the diet of Peking Man was by no means confined entirely to venison, for in addition the Leopard, Cave Bear, Sabre-tooth Tiger, a huge Hyaena, Elephant, Rhinoceros (2 species), a large Camel, Bison, Water Buffalo, Wild Boar, Horse, the Roebuck, a twisted-horned Antelope, the Big-Horned Sheep, and beasts of the Musk-Ox family all fell victims to this early hominid hunter. One can only speculate regarding the actual hunting methods used by the *Sinanthropus* population of Choukoutien; on the basis of analogy with modern food-gathering groups, however, it seems probable that some form of missile was employed,[36] since there is no evidence that more advanced techniques, such as snares and traps (or both) of various types, were evolved until Man had at least attained a primitive agricultural level of development. In any case, the presence of extensive hearths, associated with artifacts and charred bones, suggests that *Sinanthropus* probably roasted his meat. Charcoal fragments from these hearths have been identified as belonging to a species of Redbud (*Cercis blacki*), a leguminose shrub generally indicative of a temperate climate with a somewhat greater rainfall than that which prevails in the region at present.[37] To supplement his meat diet, Peking Man ate the Hackberry (*Celtis barbouri*), a small fruit similar to the cherry, seeds of which were found in a crunched condition in the deposits.[38] As regards climate during the time of occupation, the faunistic association, together with the scanty evidence of the flora, "points to a milder and damper climate than the present one."[39] Now, in spite of the fact that it has been suggested on several occasions that the *Sinanthropus* deposits at Choukoutien are the same age as the First Interglacial Stage in Europe (Cromer Forest Bed), the writer feels somewhat reluctant to attempt such broad-scale correlations on the basis of the existing data. In terms of the glacial sequence established in Kashmir by Dr. de Terra, however, it seems very probable that Locality 1 was occupied during Second Interglacial times, as shown on table 1. This dating is further confirmed by the evidence of

[34] Compare Teilahrd, 1941: 49 and 58.

[35] Compare Teilhard and Pei, 1932: 355–357; Black, 1934: 115–116; Teilhard, 1941: 58–59.

[36] Probably some type of wooden throwing stick or (?) even a spear. In this connection, Garrod (1946: 17) has recently observed that "clearely he [*i.e., Sinanthropus*] must have possessed at least some kind of spear, and since no possible spearheads either of stone or bone have been found among the relics, this must have been made entirely of wood."

[37] Black, 1931; Chaney and Daugherty, 1933.

[38] Chaney, 1935*a*; 1935*b*.

[39] Black, Teilhard, *et al.*, 1933: 50.

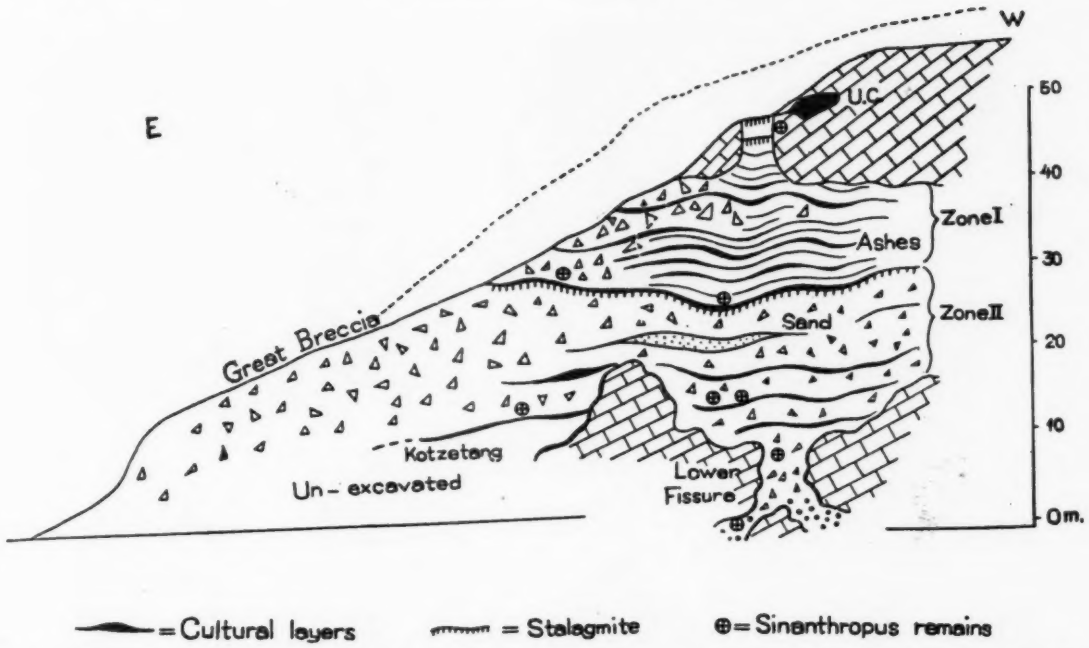


FIG. 34. Generalized section showing the deposits at Choukoutien: Locality 1, the *Sinanthropus*-Site. Zone I (*upper*)—Mostly ashy and clayey. Zone II (*lower*)—Mostly brecciated. The present deposit apparently results from the upward and westward shifting (by a succession of collapses) of an originally complex cavity that opened northeastward. Note the gradual migration of the cultural layers towards the West, and the dominance of breccias along the Eastern slope. U. C.—Upper Cave. (After Teilhard, 1941.)

the contemporary red loams which were forming at this time on the North China Plain.[40]

The main focus of attention at the beginning of the Choukoutien excavations was on the palaeontological and fossil hominid material; hence the presence of implements in the deposits was overlooked. As previously stated, it was not until the 1930–1931 season that any actual human implements were recorded.[41] Subsequently, however, a large series has been collected, but in comparison with the enormous quantity of artificially broken stones, chips, waste, and trimming flakes, etc., the total number of worked implements is very small. Indeed, as Dr. Grahame Clark has recently observed, "the crudely fractured pieces of stone from Choukoutien would never, in the vast majority of instances, have been recognized as showing traces of artificial work had they been recovered isolated in a geological deposit." [42]

A wide variety of stone was employed by *Sinanthropus* in the process of implement manufacture: fine-grained green sandstone, vein quartz, quartz crystal, quartzite (rare), volcanic rocks (rare), Sinian chert (abundant in the upper portion of the deposit), flint (rare) and in some cases limestone from the Choukoutien Hill. Pebbles of sandstone and quartz were obtained in the bed of the nearby river, and there are outcrops of vein quartz in the vicinity of the site. Crystalline quartz was probably secured in the granite massifs a few miles distant. Since no complete report has yet appeared covering the entire range of the archaeological material, the following summary is a synthesis based on the works of many authors.[43] In the light of the new discoveries made during the last ten years in Southern and Eastern Asia, the terminology used here differs somewhat from that advocated in the works listed below, especially with regard to the pebble-tools.

Choppers

As in the Early Soan of Northwestern India and the Early Anyathian of Upper Burma, core implements, which consist for the most part of pebble-tools, are important in the Choukoutienian. At the *Sinanthropus* locality many are made of a hard green sandstone, but quartz, quartzites, and other rocks were also used, and generally the natural shape of the original water-worn pebble can be recognized. The main types include choppers and chopping-tools (figs. 35 and 36), which are

[40] Compare Movius, 1944: 51–53.
[41] Pei, 1931*a*; Breuil, 1931.
[42] Clark, J. G. D., 1946: 33.
[43] Black, 1934: 110–111; Black, Teilhard, *et al.*, 1933; Breuil, 1931; 1932*a*; 1932*b*; 1935; Pei, 1931*a*; 1932, 1937*a*; 1937*b*; 1939*a*; 1939*b*; Teilhard, 1941: 60–62.

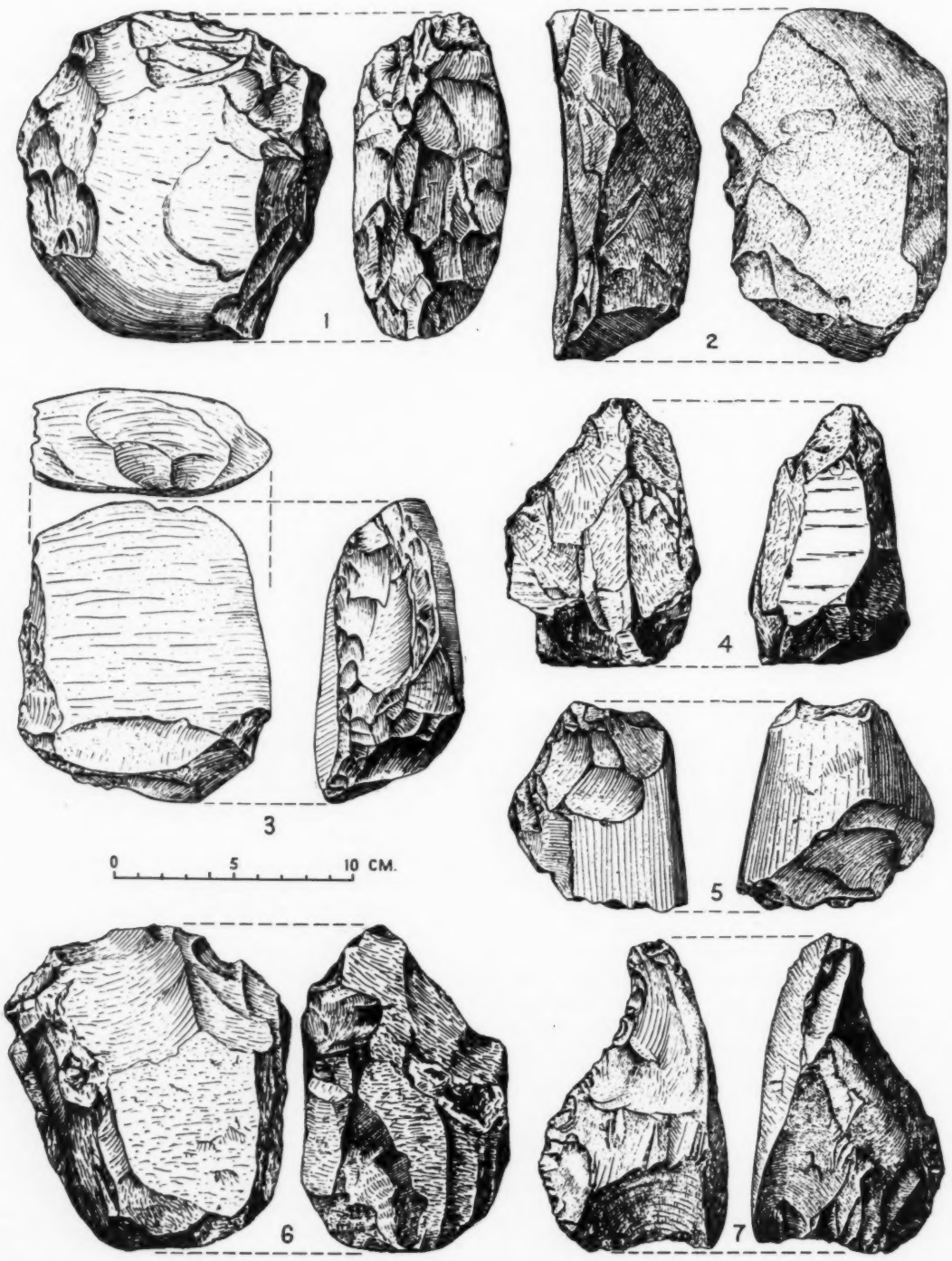


FIG. 35. Choppers and chopping-tools from Choukoutien: Locality 1.
(Courtesy of the Cenozoic Research Laboratory of China.)

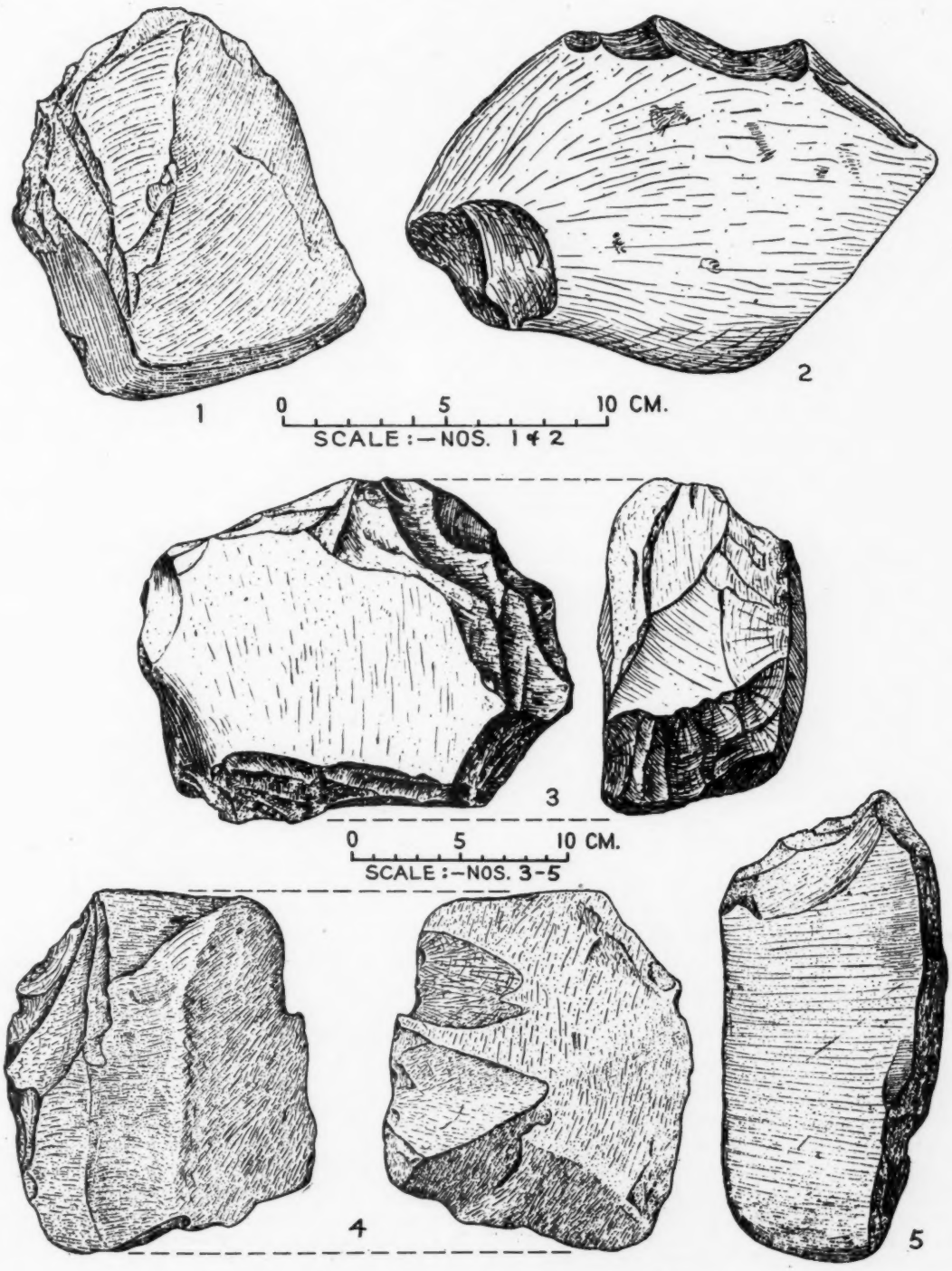


FIG. 36. Choppers made on pebbles from Choukoutien: Locality 1.
(Courtesy of the Cenozoic Research Laboratory of China.)

usually large and heavy—up to 21 centimeters long. A large number of the choppers are very crude, consisting of more or less circular, oval, or elongated pebbles roughly worked by the removal of several flakes along the upper surface of one side to produce a fairly sharp cutting edge (fig. 35, no. 2; fig. 36, nos. 1, 2, and 5). More highly evolved examples, in which one or more sides have been sharpened by the removal of a series of consecutive flakes along the upper surface of one edge (fig. 36, no. 3), are also found. The cutting edges of these specimens are steep, and the flaking has been executed upward from the unprepared base of the pebble. In some cases, these implements have been worked on three sides (fig. 35, no. 3). A few crude, double-sided choppers with inverse flaking (fig. 35, no. 5; fig. 36, no. 4), which have analogies in the Early Anyathian and Soan cultures, have been described. These are flaked on the upper surface of one side and on the lower surface of the other. Some of the Choukoutienian choppers have been roughly chipped at the butt-end (fig. 35, nos. 4 and 6), presumably to facilitate in holding.

Chopping-tools

A small series of sandstone pebbles have been worked on each side of the cutting edge to produce true chopping-tools (fig. 35, no. 1). As Drs. Teilhard and Pei point out, this has led to "the formation of a clear zigzag edge, due to the alternating ablation of tangential flakes."[44]

Flake Implements

Flake implements (fig. 37, nos. 1–13) are especially characteristic at Choukoutien: Locality 1; in fact they are far more numerous than are core tools. The general impression one receives, however, on examining a large series of them is that for the most part they are the result of the artisan having taken advantage of the accidental shape of the splinters and chips produced by primary flaking, rather than following a definite technique of shaping the stone. Two basic methods of manufacture have been employed: (*a*) direct percussion with a hammer-stone, by which roughly oval or subspheroid, fairly thick flakes were obtained, and (*b*) the so-called "bipolar" technique, producing small, quite regular flakes (e.g., fig. 37, no. 12). In the latter process, a fragment of quartz was held on an anvil and struck with a hammer-stone, which split the pebble and caused the resulting flake to exhibit what appear to be two points of percussion—one at either end.[45] Flakes produced by this hammer-stone and anvil method were subsequently used (compare fig. 37, no. 13).

Although in a few cases several small facets may be observed on the striking platform of the flake, these seem to be accidental. In general, flakes indicating careful core preparation are very rare, since often a large area of the original cortex is present. Plain striking platforms are typical; these are frequently at a high angle (greater than 90°) to the long axis of the flake, which suggests the so-called "Clacton" technique. Secondary working, if present, is always very rudimentary, although signs of use are clearly apparent on many specimens. The common types of flake implements are as follows:

(*a*) *Scrapers*—A few scrapers are made on small pebbles or flakes of sandstone, but the majority are on small flakes of quartz or quartz crystal. Side scrapers are the most numerous (fig. 37, nos. 1 and 2), discoidal types are less frequent (fig. 37, no. 11), whereas convex (fig. 37, nos. 3 and 4) and concave (fig. 37, nos. 5 and 6) examples are rare.[46] Scrapers are also made on bipolar flakes (fig. 37, no. 13). For the most part the working is crude and irregular and extends along one, or occasionally two edges of the implement.

(*b*) *Beaked Implements*—Distinctly beak-shaped implements have been produced by working two adjacent sides of an angle on a flake in a roughly concave fashion (fig. 37, no. 10). The retouching is generally steep and executed from the lower surface.

(*c*) *Points*—No clearly defined types of pointed implements have been observed, but a few flakes have been definitely worked for the purpose of obtaining a point (fig. 37, nos. 7–9). In several instances bipolar flakes have been used.

In addition to the above types, Professor Breuil claims that rudimentary examples of burins or gravers occur in the *Sinanthropus* deposits, but Dr. Pei states that on the basis of European standards, the alleged Choukoutien "burins" seem very doubtful, if not accidental.[47] With this latter opinion the writer is in complete accord.

Cores

It is a surprising fact that cores are not numerous in the rich lithic series from Choukoutien: Locality 1. Usually they are made of quartz, and in some cases the sharp edge has been subsequently used for scraping and/or cutting. They are small to medium-sized, since the diameter is stated to vary between 4 and 8 centimeters. Two main types have been recognized, as follows:

[44] Teilhard and Pei, 1932: 330.

[45] Black, Teilhard, *et al.*, 1933: 120; Breuil, 1935: 742.

[46] As Dr. Davidson Black has pointed out, some of the massive scrapers are really small choppers or cleavers (Black, 1934: 111).

In view of the difficulties encountered in working quartz, one cannot help being impressed by the range of tool types produced by *Sinanthropus*. In this connection, Dr. von Koenigswald (1942: 219) is of the opinion that "if he (Peking Man) had used flint, we should be astonished at the various tools he was able to produce."

[47] Breuil, 1935: 742; Pei, 1937*b*: 361.

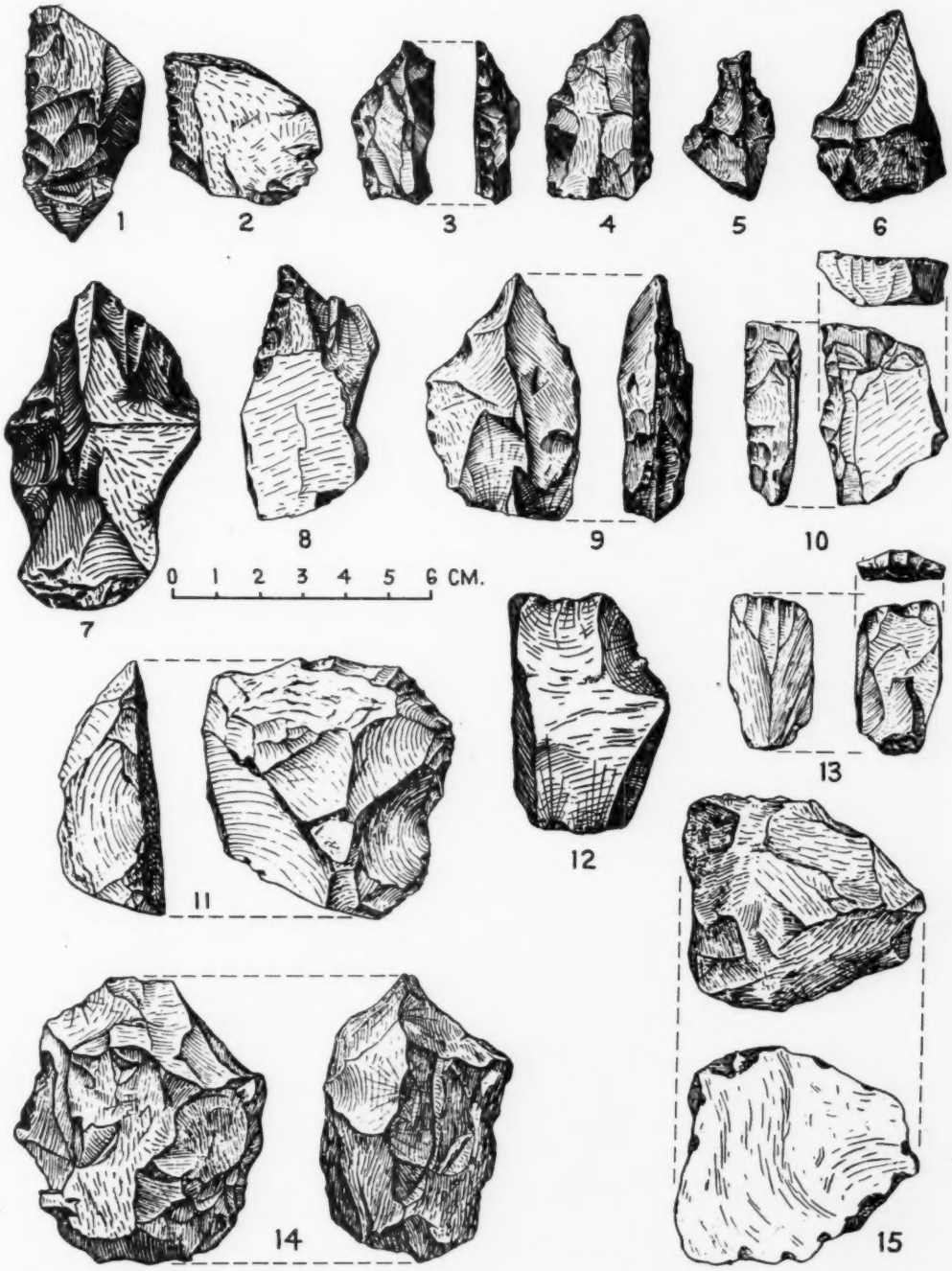


FIG. 37. Flake implements and cores from Choukoutien: Locality 1.
(Courtesy of the Cenozoic Research Laboratory of China.)

(*a*) *Discoidal Cores*—As in the Early Soan (see p. 379) roughly discoidal cores (fig. 37, no. 14), with edges irregularly worked all around the periphery, are the most typical. The two rows of opposing flake scars tend to produce an edge with a scalloped outline. In section these cores are either oval or flat, depending on the number of flakes that have been detached from them.

(*b*) *Conical Cores*—Cores that are roughly conical in section (fig. 37, no. 15) have resulted in the case of nodules from which flakes have been removed all around the periphery in an upward direction from the roughly circular, unprepared base of the pebble.

In addition, there are a few cores made on pebbles with plain striking platforms, formed by the removal of a single flake. Several hammer-stones, made of fragments of the hard fine-grained limestone of the hill, have also been found. These, together with the thousands of chips and trimming flakes that occur in the deposit, demonstrate that the occupants did their knapping at the site.

In the stalagmitic layers in the upper portion of Zone I of the *Sinanthropus* deposits an interesting series of large implements made of Sinian chert was discovered.[48] These are stated to be deeply patinated and to include many large flake implements carefully worked into scrapers. To date, however, only two of these objects—a well-worked, concave side-scraper (fig. 35, no. 7), and an excellent example of a discoidal scraper (fig. 37, no. 11)—have been published. According to the excavators, "nothing so elaborate has been found thus far in Locality 1."

There is a certain amount of controversy concerning the existence of a so-called "bone and antler industry" at Choukoutien.[49] On the one hand, the various members of the Cenozoic Research Laboratory in Peking believe that only some of the thousands of fragments of bone and antler reveal definite traces of working and/or utilization. On the other hand, Professor Breuil has contended that both bone and antler were worked on a very extensive and elaborate scale by Peking Man. Until this matter is reported on in detail, therefore, it must be left in suspense. In the meantime, Dr. Pei has made an exhaustive study of the effects of various gnawing and crunching animals on bones.[50] It is the writer's opinion that the Chinese scientists are correct, and that Professor Breuil has very much overstated the importance of bone and antler artifacts at Choukoutien.

Without any question the best implements found anywhere in the 50 meters of cultural deposits at the *Sinanthropus* site are the chert tools from the stalagmitic layers in the upper portion of Zone I. These demonstrate what this very primitive hominid could do when he obtained a good grade of raw material. Otherwise, there is little typological change apparent anywhere in the deposits. According to Dr. Teilhard, "pebble-made implements are especially abundant in the Lower Zone, and quartz-splinters become dominant in the Upper Zone of Locality 1. No sharp separation, however, seems to divide in the site the two different industries."[51] Indeed, it seems apparent on the basis of present data that the whole matter concerns the relative quantity of the various types of implements, since both quartz flakes and pebble-tools occur throughout. Furthermore, the archaeological material from Locality 15, chronologically later than Locality 1, proves that even during Late Choukoutienian times there is very little typological difference between either of the two main Lower Palaeolithic (Choukoutienian) industries in North China.

LOCALITY 15

Excavations undertaken in a cemented fissure deposit, situated only 70 meters south of Locality 1 and known as Choukoutien: Locality 15 (see map 3), have produced not only an interesting collection of palaeontological material, but also an important series of implements typical of the Late Choukoutienian culture.[52] But the thick bone breccia at this site, excavated to date to a depth of 10 meters, has not as yet yielded any remains of *Sinanthropus*. The probability is, however, that the occupants of Locality 15 were of the same race and the lineal descendants of *Sinanthropus*, if we may judge by the cultural material. As in the case of Locality 1, this site was once a cave, the present deposits of which occupy an area 16 meters long by 13 meters wide. As stated on pages 345 and 348, the fauna from Locality 15 is somewhat later than the typical Middle Pleistocene assemblage of Locality 1, and, since it includes forms very characteristic of the Upper Pleistocene Malan Loess, it has been correlated with the Third Glacial Stage in the Himalayan sequence. Such a dating is further indicated by the white calcified tubes and worm-like concretions found in the upper portion of the deposits, which could only have been formed under the conditions of a cool, semi-arid climate of a continental glacial episode. Desertic conditions are further implied by the presence of Jerboa and Ostrich in these fissure deposits, forms which, as Dr. de Terra has pointed out, could not live on the North China Plain during a mild, temperate Interglacial Stage.[53] In any case, from an archaeological

[48] Teilhard and Pei, 1934: 382–383.

[49] Breuil, 1931; 1932*a*; 1932*b*; 1935; 1938; 1939; Pei, 1931*a*: 1932; 1937*a*: 225; 1937*b*: 361; 1938; 1939*a*: 8; Teilhard and Pei, 1932: 354; Black, Teilhard, *et al.*, 1933: 130; Black, 1934: 111.

[50] Pei, 1938.

[51] Teilhard, 1941: 61–62.

[52] Teilhard, 1935; Pei, 1937*a*: 225–226; 1939*a*: 8; 1939*b*: 129; 1939*c*.

[53] de Terra, 1941: 34.

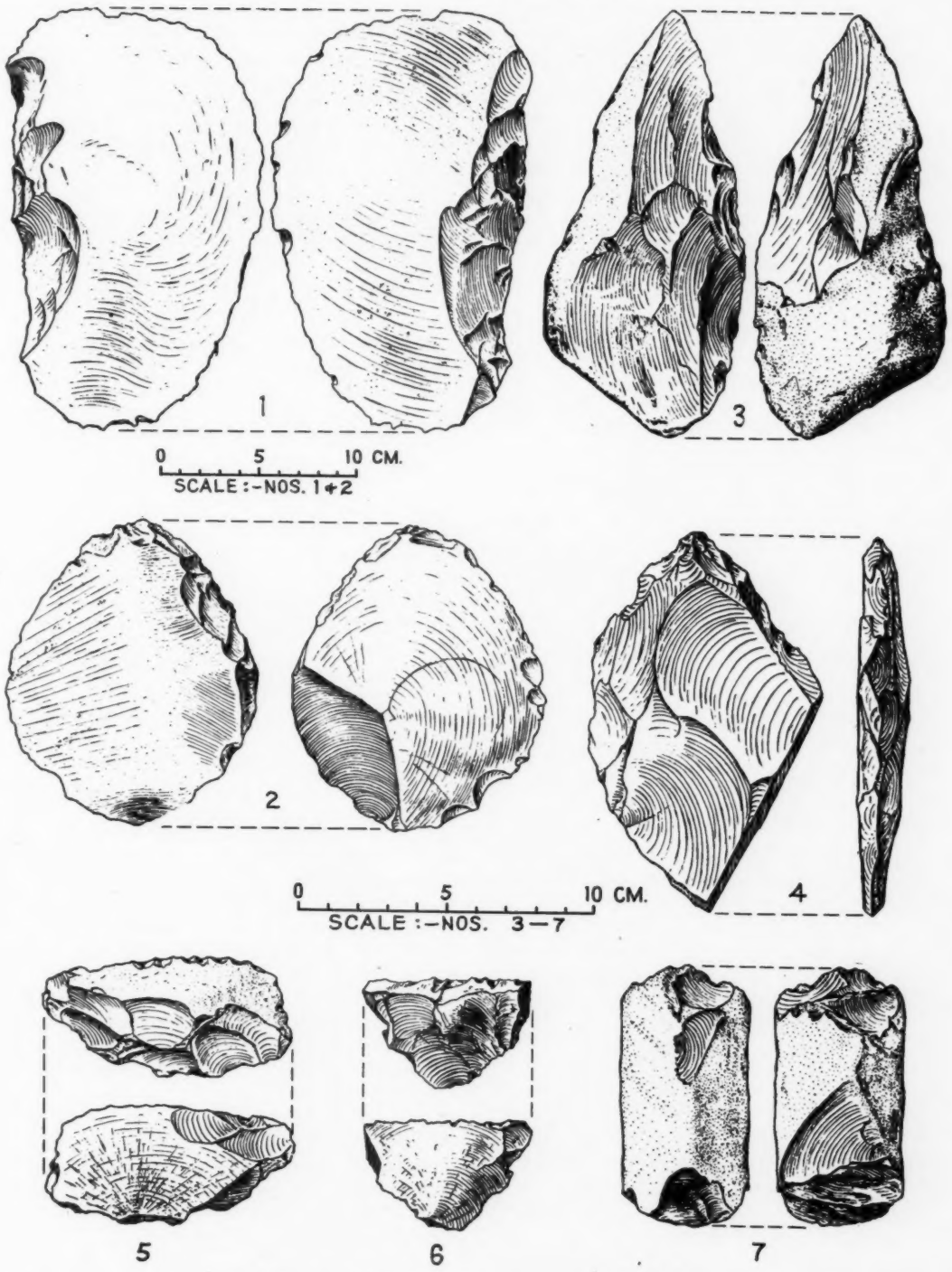


FIG. 38. Late Choukoutienian implements from Locality 15.
(Courtesy of the Cenozoic Research Laboratory of China.)

point of view, the Late Choukoutienian from Locality 15 is unquestionably more advanced in several respects than that found in the *Sinanthropus* deposits, a fact that agrees with the evidence of the fossils.

At a mid-point in the Locality 15 section several layers were found containing ash deposits, Hackberry (*Celtis*) seeds and burnt bones, but hundreds of well-worked and interesting stone implements were found throughout. The layers were not subdivided into different cultural horizons, since no difference in the archaeological material from any one layer could be detected. In general, the Late Choukoutienian of Locality 15 is very similar to the series from Locality 1, but on the whole the implements are better retouched, and many more types of tools can be recognized. In addition to quartz, a hard green sandstone, Sinian chert, flint, volcanic rocks, slate, and limestone were employed in the process of implement manufacture. As regards the core implements from this site, they are mostly made of sandstone, a few of volcanic rocks, and one of slate. Although supplemented by additional information, the following summary is mainly based on Dr. Pei's preliminary report [54] on the archaeological material from Locality 15.

Choppers

In general, these are very like examples from the *Sinanthropus* site. Choppers are usually made on roughly circular, oval, or subangular pebbles (fig. 38, no. 3), flaked on the upper surface along one edge, but discoidal and semi-discoidal types (fig. 39, no. 1) also occur. For these a flat, angular pebble appears to have been used.

Chopping-tools

At Locality 15 there are some small chopping-tools (fig. 38, no. 4), worked on both sides of the cutting edge, often in an alternating manner. These are made on pebbles that are either oval, circular, or flat in section. In the case of the latter, roughly discoidal implements have been produced that are sharpened along two or even three sides of the tool.

Pick-like Implements

Several examples of pick-like implements (fig. 38, no. 7) have been recovered at Locality 15. These are made on elongated pebbles with truncated ends. Larger examples of this type of implement are also known from Locality 1 (compare fig. 36, no. 5).

Cleavers

Among the various types of massive flake implements found at this site are three large, thin, oval cleavers (fig. 38, nos. 1 and 2),[55] fashioned from sandstone (two specimens) and a fine-grained siliceous rock (one specimen). These flakes display prominent bulbs, and in the only case where the bulbar end has not been extensively worked the striking platform is plain and at a high angle to the flake's axis (fig. 38, no. 2). Cortex on the upper surface of each indicates that these implements were struck from unprepared boulders. The careful chipping of the bulbar end was apparently designed to facilitate holding, since the working edge in all but one case is sharp and only slightly chipped as a result of use.

Flake Implements

Direct percussion was the technique employed in the production of flakes, as at Locality 1. Although a few, well-made triangular flakes of chert (fig. 39, no. 7) with plain striking platforms reveal careful core preparation prior to removal, this is unusual. It is a puzzling and as yet unexplained fact that the bipolar technique, so definite a feature of the flake industry at the *Sinanthropus* site, is absent. On the whole, retouched forms are rare, but whereas the Locality 1 specimens seem to be for the most part accidental shapes, this is not the case with many of the flake implements from this site. Furthermore, both flat secondary working, and a steep, almost vertical, retouch appear for the first time. Signs of use along the edges of the typical, small, irregular flakes are commonly indicated by minute step-flaking and "nibbled" edge working. Many types of scrapers are present: side, convex, concave, double side, and pointed or beaked types. A few have been manufactured from small pebbles, 2 to 4 centimeters in diameter, worked along one edge (fig. 39, nos. 5 and 6). One special type—a trapezoidal scraper (fig. 38, no. 6)—appears; it is made on a flake that has an expanded working edge opposite the bulbar end, which has been retouched. There are also a few "side-blow" flakes, apparently used as scrapers (fig. 38, no. 5). Points are very common (fig. 39, nos. 8–12), and on the whole very much more highly evolved than those from Locality 1. One of the most interesting types in the Late Choukoutienian series is a small, almost leaf-shaped point (fig. 39, no. 10), worked by flat secondary flaking along both edges. Often the lower surface of these implements has been retouched as well, producing a small *biface* or *semi-biface*. Implements in the point category are also made on small pebbles (fig. 39, nos. 3 and 4). Beaked implements from Locality 15 are on the whole very similar to those from Locality 1, and, as in the latter deposits, true burins or gravers are absent.

[54] Pei, 1939*c*.

[55] The third specimen, illustrated by Dr. Teilhard (1941: 61, fig. 29; also Pei, 1939*c*: 175, fig. 19*a*), is stated to be very similar to a quartzite implement found in the Lower Zone of Locality 1.

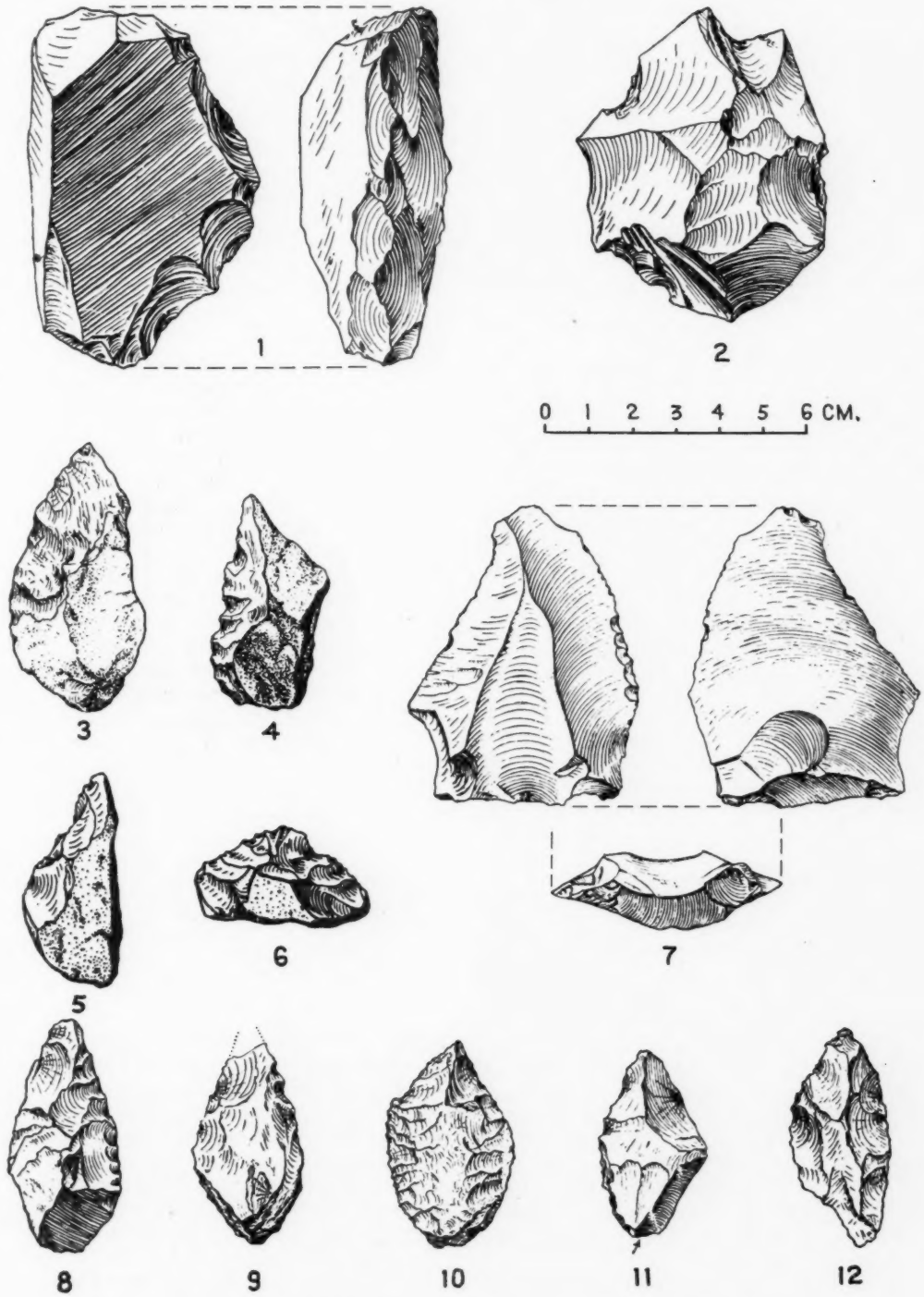


FIG. 39. Late Choukoutienian implements from Locality 15.
(Courtesy of the Cenozoic Research Laboratory of China.)

Cores

With the exception of several well-prepared polyhedral cores of chert (fig. 39, no. 2), the Locality 15 examples include only the same roughly discoidal types described above (see p. 398). In some instances cores with sharp edges have been secondarily used for scraping and/or cutting tools.

From the point of view of cultural tradition, the Late Choukoutienian of Locality 15, although unquestionably more advanced, is positively and closely related to the typical Choukoutienian of Locality 1. As a whole, the implements from the former site are better retouched. Characteristic innovations at Locality 15 include triangular flakes struck from previously prepared cores, trapezoidal scrapers, "side-blow" flakes and small bifacial or semi-bifacial points carefully worked by flat flaking. Indeed, from a technical point of view the latter may be considered perhaps the most highly evolved single class of tools from the site. Thus the archaeological data are in complete agreement with the evidence of the fauna as regards the fact that Locality 15 is younger—early Upper Pleistocene (Third Glacial Stage)—than Locality 1—which has been assigned to the late Middle Pleistocene (Second Interglacial) Stage.

SUMMARY AND CONCLUSIONS

On the basis of the facts summarized above, the following deductions concerning the material culture and activities of *Sinanthropus* seem permissible:

(*a*) The core and massive flake implements he employed in connection with his food-gathering activities were in the chopper—chopping-tool tradition. Indeed, the essential conclusion that emerges from a study of the Choukoutienian culture is that hand-axes (*bifaces* or *coup-de-poings*) are completely absent. The rather unspecialized quartz industry that he also produced was apparently developed as a result of the abundant and readily available supply of this material, which is very difficult to work, rather than its being due to a continuum of a more widely practiced cultural tradition.

(*b*) His favorite meat was venison (seven-tenths of the animal bones from the site are those of Deer), but he hunted and killed other wild beasts as well, including such swift-footed ruminants as Gazelle and Horse. The actual methods employed by *Sinanthropus* in hunting, however, are as yet unknown, but it seems very unlikely that he used traps and snares, or other mechanical devices, on the basis of analogy with modern food-gathering peoples.

(*c*) Fire was a basic item in his daily life. He presumably cooked his meat over the open hearth in which he burned the wood of the Redbud (*Cercis blackii*), a type of shrub. Since fire would have provided warmth in the then-existing cave, and since it would keep predatory animals away at night, it must have been an immense asset to him.

(*d*) To supplement his meat diet, he ate a small, cherry-like fruit, the Hackberry (*Celtis bar-bouri*), which grew in the vicinity.

(*e*) He had learned to live under the conditions of a north temperate climate with moderately long winters. Thus, as Dr. Sauer has recently observed, "habitat and cultural remains alike show that we are not dealing with improvident half-apes, but with men who were applying thought and fore-thought to living in a fairly exacting environment." [56]

(*f*) Although traces of some forty-five individuals have been recovered to date, there are no indications that *Sinanthropus* buried his dead. On the contrary, there is every reason to believe that he was a cannibal with a special taste for human marrow and brain. Furthermore, various marks on the skulls demonstrate that in many instances individual *Sinanthropi* met with violent deaths.

(*g*) In conclusion, the long continuum both of racial type and cultural tradition represented in the deposits is extraordinary. This fact has recently been stressed by Dr. Teilhard,[57] who states "I wish only to emphasize here the strange stability of the type throughout the 50 meters of sediments forming the two zones of Locality 1.[58] Most remarkably, not a single anatomical difference can be detected between the skull remains found at the very bottom and those collected at the very top of the deposits. This morphological stability is interesting in two ways: first as an indication that *Sinanthropus* already can be held responsible for the implements found in Locality 13; and secondly as evidence of the slowness which characterizes biological evolution whenever not obscured, disturbed or accelerated by intrusive immigration of foreign elements."

The closest analogies for the Choukoutienian—the culture of *Sinanthropus*—are with the Early Soan of Northwestern India and the Early Anyathian of Upper Burma.[59] It belongs to the great chopper—chopping-tool Lower Palaeolithic culture complex now recognized in Southern and Eastern Asia.[60] The evidence from the early archaeological horizons at Choukoutien, taken as a whole and compared with the already more

[56] Sauer, 1947: 4.

[57] Teilhard, 1941: 59–60.

[58] "For 20 meters of deposits in the Castillo Cave (North Spain) ten different human cultures were observable, ranging from a Lower Mousterian to a Late Magdalenian."

[59] Compare Movius, 1944: 76.

[60] See Le Gros Clark, 1946; Braidwood, 1947.

progressive "West," indicates that Middle Pleistocene China "seems to have represented (on account of its marginal position) a quiet and conservative corner amidst the fast advancing human world." [61]

VIII. PALAEOLITHIC FINDS FROM OTHER REGIONS IN SOUTHEASTERN ASIA

In addition to the well-documented and demonstrably Pleistocene archaeological finds from Java, Burma, Northwestern India, and Northern China described above, a substantial amount of material has come to light in recent years indicating that other regions in Southeastern Asia were also occupied by Palaeolithic Man. This evidence, some of which is still unpublished, will be briefly summarized in the following pages, but, before any dogmatic statements can be made concerning its significance, it will be only too apparent in each case that there is an urgent need for further intensive field-work.

MALAYA

In 1938 Mr. H. C. Collings of the Raffles Museum, Singapore, discovered an important and very prolific Lower Palaeolithic site on the rubber estate at Kota Tampan in Northern Malaya (see map 1).[1] This locality is situated on the western side of the valley of the Perak River, some 3½ miles south of Lenggong in Upper Perak. The implements, which consist mainly of choppers, were found *in situ* in a river gravel, presumably a terrace deposit, near the northern end of Lake Chenderoh at a height of approximately 250 feet above sea-level. Mr. Collings has proposed the name *Tampanian* for this apparent Lower Palaeolithic development in Malaya. However, because of the war, no detailed report on the site and the implements found there has yet been published.

It cannot be conclusively demonstrated on the basis of present data that the implementiferous horizon at Kota Tampan is of Pleistocene age, but there are several indications that this is so, which may be summarized as follows:

(*a*) Typical Mesolithic and Neolithic implements have been collected in the vicinity in a deposit of volcanic tuff which immediately overlies the sands and gravels containing the Palaeolithic-type tools. This fact suggests a Post-Pleistocene antiquity for the upper stratum.

(*b*) The sands and gravels in question contain tin, and in 1905 a fossilized tooth of *Elephas namadicus* was found in a similar tin-bearing deposit at Selak North, situated at the southern end of Lake Chenderoh.[2] To date no fossils have been found at the Kota Tampan locality, but, since it is very unlikely that such tin gravels would have formed during the Recent Period, it seems probable that, if and when such finds come to light, they too will represent extinct forms.

All the implements thus far collected at Kota Tampan are made on quartzite pebbles, and, as with the Soan, Anyathian, Patjitanian, and Choukoutienian, a conscious effort seems to have been made in most cases to produce tools with the minimum amount of work. Hence a large area of cortex is usually present. In all instances the tools are heavily rolled and patinated, and implements made on pebbles are characteristic throughout.

CHOPPERS

Pebble tools flaked on the upper surface of one end to form a round to oval cutting edge are typical of the series from Kota Tampan (fig. 40, nos. 1–4). Some steep-ended forms are present with edges at an angle varying between 75° to 85° with the base of the tool, as well as a few side choppers.

CHOPPING-TOOLS

Some very well made chopping-tools, a few with alternately flaked, serrated edges, were noted in Mr. Collings' collection.

PROTO-HAND-AXES

As in Java (see p. 356, and fig. 11, nos. 2 and 3; fig. 14, no. 4), a few proto-hand-axes, or pointed, more or less plano-convex pebble tools (fig. 40, no. 5) have been recorded.

HAND-AXES

According to information received from Mr. Collings, several crude hand-axes were found at Kota Tampan. They are made on pebbles, and the flaking is longitudinal, or parallel to the long axis of the artifact, in the chopper tradition (see p. 361). Indeed there is an apparent typological development from pointed implements of the chopper—chopping-tool variety grading into proto-hand-axes, while more evolved examples of the latter may be considered true hand-axes. Whether or not on this basis, together with the fact that hand-axes are apparently absent in Burma, one is justified in concluding that implements of the hand-axe type were developed independently in the Far East is not absolutely clear, but the present data suggest that they probably were. In any case, the overwhelming majority of the Tampanian implements are *unifaces* (choppers flaked on the upper surface only) rather than *bifaces*, a fact which also holds true of the Patjitanian of Java.

[61] Teilhard, 1941: 60.

[1] Collings, 1938; Tweadie, 1942: 1–2.

[2] Andrews, 1905: 81.

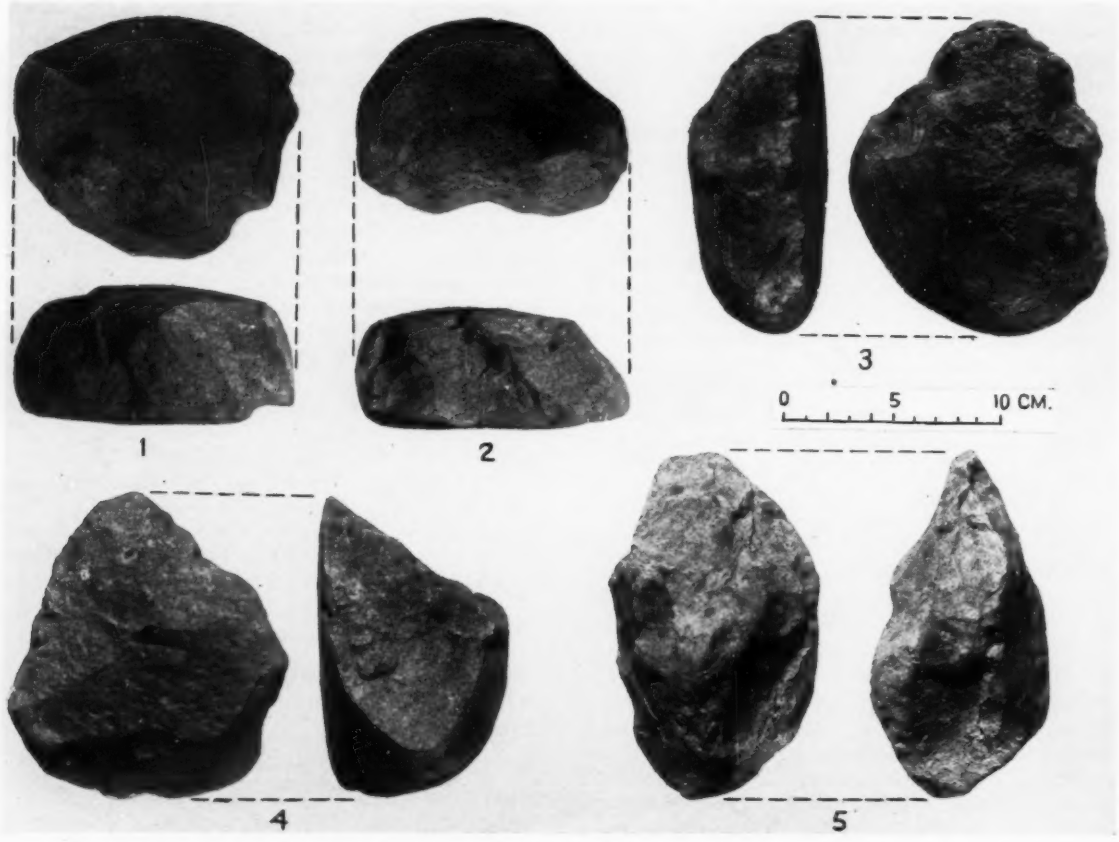


FIG. 40. Implements of Lower Palaeolithic type from Kota Tampan, near Lenggong, Upper Perak. (Courtesy of Raffles Museum, Singapore.)

FLAKE IMPLEMENTS

These include hollow scrapers made on large flakes, as well as side scrapers and points made on small to medium-sized flakes. (A few implements classed as scrapers made on pebbles occur.) Many retouched flakes that display edge chipping as a result of use were also found. Although several small and finely worked flakes are present, most of them have been struck from very crudely prepared cores. The striking platforms are plain, some of them never having had the original cortex of the pebble removed from them.

CORES

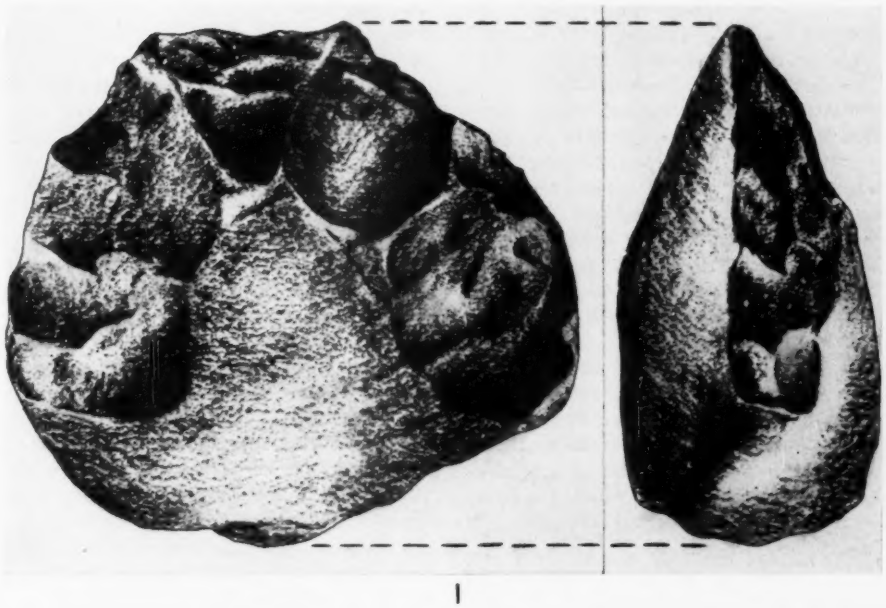
The series of cores is small. In general, they are very similar to those found in the Early Anyathian (see p. 374, and fig. 23, nos. 5 and 6). All the specimens collected thus far are heavily rolled.

The typology of the implements from Kota Tampan indicates that this material represents a Lower Palaeolithic culture which belongs to the same Middle Pleistocene complex as the Early Soan, the Early Anyathian, the Choukoutienian, and the Patjitanian.[3] Until a careful physiographic survey is made of the Upper Perak Valley, however, this statement cannot be made with certainty. In the meantime, the Tampanian can be tentatively regarded as providing additional proof of the widespread occurrence in Southern and Eastern Asia of Old Stone Age cultures in which the chopper—chopping-tool tradition is dominant.

THAILAND

During the years 1943–1944, while a prisoner of war and forced by the Japanese to work on the new Bangkok–Moulmein Railway, Mr. H. R. van Heekeren, who has recently been appointed Prehistorian of the Archaeological Survey of the Netherlands East Indies, discovered what are undoubtedly the first Palaeolithic imple-

[3] This conclusion has also been reached by Dr. Teilhard, 1938*c*: 452–453.



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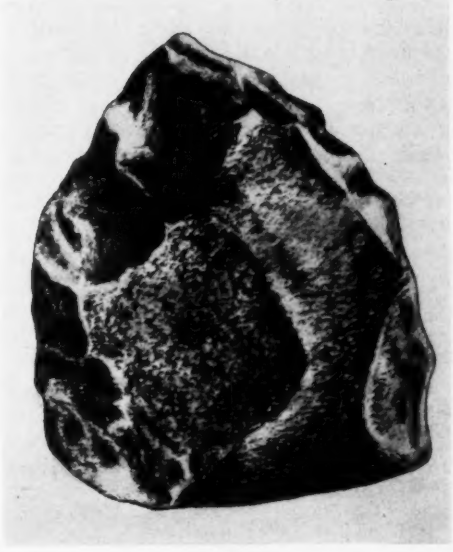

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FIG. 41. Choppers made on pebbles from Bhan-Kao in the Valley of the Fingnoi River, Southwestern Thailand. (Courtesy of the *Illustrated London News*.)

ments ever to be found in Thailand (Siam).[4] These were found near Bhan-Kao, a small hamlet situated at about 14° north latitude and 99° east longitude in the valley of the Fingnoi, or Meklong, River.[5] Near Bhan-Kao, which is actually located at Km. 86 (i.e., at a distance of 86 kilometers, or 54 miles, northwest of Ban-Pon) at a point just 44 kilome-

[4] van Heekeren, 1947*a*; 1947*b*; also a third paper which is to appear in *Proc. Prehist. Soc.* during 1949. For a summary of previous archaeological research in Thailand (Mesolithic and later finds), see Sarasin, 1933.

[5] Also known as the Menam Gwe Noi. The railway follows this valley as far as the Burma Frontier.

ters (27.5 miles) northwest of Kanburi,[6] extensive deposits of uncemented fluviatile gravels were exposed during the construction of the railway. These are composed of heavily rolled pebbles and small boulders in a matrix of coarse sand, and they are overlain by fine-grained, buff-colored sandy silt, believed to be of eolian origin. Subject to confirmation by a geologist, the gravel horizon appears to be carried on a Pleistocene river terrace that occurs at a uniform height of 20 meters above the level of the river.

The archaeological material in question was found *in situ* in the 20-meter (?) terrace gravels of the Mei Fingnoi, at a distance of about one kilometer from the river and near the hamlet of Bhan-Kao. Although scientific investigations were absolutely impossible under the circumstances, Mr. van Heekeren managed to keep in his possession three of the six specimens originally collected by him at the site, and these are illustrated in figure 41. All are core tools made on flat or oval river pebbles that have been manufactured into choppers by unifacial flaking along the upper surface of either one edge (fig. 41, no. 1) or two adjacent edges (fig. 41, nos. 2 and 3). In all cases the ventral surface is flat and unflaked, and it exhibits the original rolled and patinated crust of the pebble. A considerable range of material—quartzite, sandstone, and claystone (slate or ? shale)—was employed for the purpose of implement manufacture by the prehistoric inhabitants of the Fingnoi Valley, according to observations made at the locality.[7] In a letter to the writer from Watampone, South Celebes, Eastern Indonesia (dated Dec. 15, 1946), Mr. van Heekeren reports as follows: "The Bhan-Kao locality is enormously rich and, had it not been for the vigilance of my captors, I could have collected literally tons of both rolled and comparatively unrolled specimens there." For the Siamese version of the chopper—chopping-tool complex of Southern and Eastern Asia, Mr. van Heekeren proposes the name "FINGNOIAN." From a typological point of view the degree of similarity revealed by the newly discovered material from Bhan-Kao as compared with the silicified tuff series of the Early Anyathian culture of Upper Burma is indeed striking. It is to be hoped that in the near future it will be possible to conduct further investigations at this interesting and important locality.

INDO-CHINA

In the limestone region of Northern Indo-China near the village of Tam Hang, Haut-Laos (approximately 165 miles due southeast of Hanoi) the typically Middle Pleistocene fissure fauna of Southeast Asia, containing Malayan Bear, Tapir, Orang, *Stegodon*, and *Aeluropus*, which is found in South China (Szechwan, Yunnan, Kiangsu, and Kwangsi), Burma (Northern Shan States), and Java (Zuider Karst), is abundantly represented. Although Dr. Fromaget has claimed that he has found human remains and crude stone tools associated with this fauna,[8] Dr. Teilhard emphatically states that there is as yet no definite proof that the region was occupied by Man during Pleistocene times.[9] According to Dr. Teilhard, who has visited the locality in question, Fromaget's finds of alleged "fossil" human remains, which include several teeth and a fragment of temporal bone, as well as a portion of a modern-looking, sub-brachycephalic skull,[10] are not fossils at all and were probably derived from an overlying stratum of Post-Pleistocene brown clay. Furthermore, Dr. Teilhard reports that the supposed stone "implements" are all of an extremely doubtful nature.[11] These finds are only mentioned here to call attention to the facts that (*a*) this work has been done and presumably will be continued, and (*b*) in view of the new finds, especially those in Burma, Thailand, and Malaya, it seems extremely likely that sooner or later in the Pleistocene river gravels of Indo-China, Palaeolithic implements will also be discovered.

SOUTHERN CHINA

As Drs. von Koenigswald and Weidenreich have indicated,[12] the fossiliferous fissures of Southern China, originally described by Matthew and Granger,[13] are certainly among the most critical localities in the Old World with regard to research on the morphology of Early Man. In addition to the teeth of *Gigantopithecus blacki* von Koenigswald, however, the existence of Early Man in China south of the Tsinling Range is indicated by the following archaeological finds:

(*a*) In 1935 Drs. Teilhard, Young, Pei, and Chang investigated several caves in Kwangsi Province.[14] In one of them, Cave A, near Paochiao, Wuminghsien, northwest of Yungning, which contained a (?) Mesolithic occupation layer, a small pebble chopper made of quartzite was found (fig. 42).[15] This implement, apparently derived from river gravels of Pleistocene age, has been worked at two different periods. Since the older series of flake scars are heavily rolled,

[6] Kanburi is a large town situated approximately 68 miles west-northwest of Bangkok.

[7] All of Mr. van Heekeren's notes concerning this and other sites in the region were confiscated by the Japanese.

[8] Fromaget, 1936*a*; 1936*b*; Fromaget and Saurin, 1936; Fromaget, 1938*a*.

[9] Teilhard, 1937*a*: 215; 1937*d*: 32; 1938*c*: 456; 1941: 64, footnote 1.

[10] Compare Fromaget, 1938*b*: figs. 1–3, and pl. XII.

[11] Compare Fromaget and Saurin, 1936: 20–23, and figs. 5–10.

[12] von Koenigswald, 1935*b*: 873; 1947: 14; Weidenreich, 1944; 1945*b*: 63–94; 1946: 57–60.

[13] Matthew and Granger, 1923; also Colbert, 1942: 1454; Pei, 1935*b*; 1940*b*; Bien and Chia, 1938; Young, 1939; Young and Mi, 1941: 102–104.

[14] Teilhard, Young, Pei, and Chang, 1935; Pei, 1935*a*; 1935*b*; 1939*b*: 126.

[15] Illustrated by Pei, 1935*a*: fig. 7; Teilhard, 1941: fig. 31.

it is reasonable to assume that they antedate a stage of terrace formation—possibly during Middle or Upper Pleistocene times. Subsequently, this object was collected and reworked

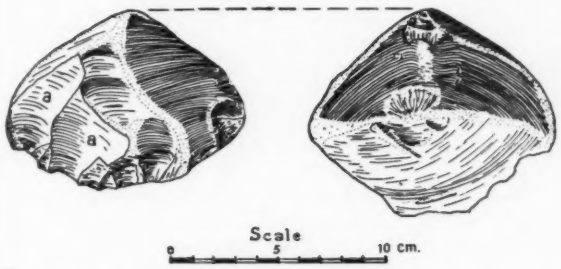

FIG. 42. Heavily-rolled Palaeolithic (?) chopper made on a pebble which has been reworked (*a*) by the Mesolithic Cave-Dwellers of Kwangsi, South China. (After Pei, 1935.)

by the occupants of the cave during the Early Post-Glacial Stage. The flakes which they detached reveal fresh, sharp scars. The evidence of this implement indicates that a systematic search of the river gravels in this area would probably establish a Palaeolithic occupation of Kwangsi as a fact rather than as a suspicion.

(*b*) According to Dr. D. C. Graham, a missionary, the Rev. J. H. Edgar, collected a small series of five crudely flaked and heavily patinated Palaeolithic-type implements somewhere along the Yangtze Gorges between Ichang and Chungking.[16] It is stated that several of these artifacts, which are made of quartzite, were found in a conglomerate composed of river pebbles "solidly cemented together by lime and other mineral substances that abound in the water of West China."[17] Two of these interesting implements, which appear to be pebble tools of the chopper or chopping-tool variety, are illustrated in figure 43. On the basis of Dr. Teilhard's interpretation of Dr. Graham's text, "these pieces *may* have been collected in the very basal conglomerate of the Itu Loam,"[18] which would indicate an Upper Pleistocene dating;[19] but they may be even older, as Dr. de Terra suggests.[20] Whatever their true geologic age may be, however, these specimens may be regarded as a definite indication that abundant traces of Palaeolithic Man will be forthcoming as soon as an intensive search of the Middle Yangtze Valley is undertaken.

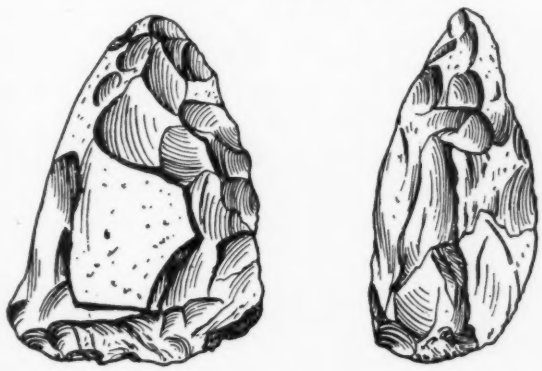

FIG. 43. Two implements in quartzite from the Late Pleistocene (?) Terrace Deposits of the Yangtze Valley between Ichang and Chungking. (After Graham, 1935, and Teilhard, 1941.)

[16] Graham, 1935; compare also de Terra, 1941: 36–37; Teilhard, 1941: 70–71.

SUMMARY AND CONCLUSIONS

On the basis of the evidence summarized above, it will be readily apparent that, as soon as political conditions again permit scientific field-work in the Far East, Southern China and adjacent countries must be regarded as potentially very fertile regions for research on Early Man.

IX. SUMMARY AND CONCLUSIONS

The foregoing facts, shown in time relationship with each other on the table (see pp. 346–347), may be summarized as follows:

1. Although human remains are known from the Lower Pleistocene (*Poetjang*) Beds of Java, where they occur in direct association with the Djetis (*Siva-Malayan*) faunal assemblage, cultural material indicating the presence of Man is unknown from Southern and Eastern Asia before the Middle Pleistocene. Then in Northwestern India (Punjab Flake Industry from the Second Glacial Boulder Conglomerate), Upper Burma (Phase 1 of the Early Anyathian from the Second Pluvial Lateritic Gravel at present exposed on T_1 and the higher valley slopes), and Northern China (small chopping-tool from Choukoutien: Locality 13 associated with a typically early Middle Pleistocene fauna) human artifacts begin to appear.
2. In at least three of the archaeological areas considered in this paper, the main Lower Palaeolithic development apparently occurred during Second Interglacial or Interpluvial times—Phase 2 of the Early Anyathian, the Early Soan of the Punjab, and the Choukoutienian of the *Sinanthropus* deposits (Choukoutien: Locality 1) of Northern

[17] Graham, 1935: 48.
[18] Teilhard, 1941: 71.
[19] Compare Teilhard and Young, 1935; Barbour, 1935*a*.
[20] de Terra, 1941: 36–37.

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China. As regards the Patjitanian of Java, the data presented on pages 352–355 suggest a late Middle Pleistocene—early Upper Pleistocene age for the material, which is in accord with the somewhat advanced nature of the implements from a typological point of view.

3. As indicated by the presence of certain specialized types of tools, the Patjitanian of Java is undoubtedly more advanced than any of the other assemblages considered in this paper. This is revealed by the occurrence of hand-axes, which, on the basis of existing data, are completely absent in Upper Burma, China, and the true Early Soan of Northwestern India. However, not only are the Patjitanian hand-axes flaked in a manner reminiscent of that exhibited by choppers, chopping-tools, and hand-adzes, and therefore easily distinguished from true Acheulian or Madrasian *coup-de-poings*, but also they comprise only 6.32 per cent of the total series from the type locality.[1] It seems probable, therefore, that the Lower Palaeolithic hand-axes of Java are to be regarded as the result of independent development and not due to outside influence, a view which is strengthened by the complete absence throughout the Far East of a well-developed Levalloisian technique. The latter invariably accompanies the more specialized hand-axe cultures in other sections of the Old World;[2] in fact the known distribution of each is very nearly coincidental.
4. Collectively, the group of cultures under discussion form part of a great Lower Palaeolithic complex, the recognition of which, as distinct from the classic development found in other areas of the Old World, is directly due to an appreciation of the significance of the discovery of the Anyathian culture of Upper Burma.[3] The salient features which characterize this new focus of Lower Palaeolithic development are:

   (*a*) The presence of an overwhelmingly high proportion of core implements of the chopper—chopping-tool and hand-adze varieties, associated with plain, unprepared flakes and nuclei.

   (*b*) When due allowance is made for geographical considerations, the degree of uniformity displayed by the cultural material from each of the areas considered here is extraordinary. The typological differences revealed by the individual tool types of one region as contrasted with those of another are on the whole of a relatively minor nature, and in part at least seem to be directly connected with the inherent properties of the various raw materials used in each case—e.g., the quartz industry from Choukoutien: Localities 1 and 15, and the fossil wood industry of the Anyathian culture of Upper Burma. But it is impossible to explain the complete absence of hand-axes in Burma and China on the basis of the latter factor.

   (*c*) In comparison with contemporary developments in Europe, Africa, and the Near East, the chopper—chopping-tool complex of Southern and Eastern Asia displays surprisingly little chronological change.

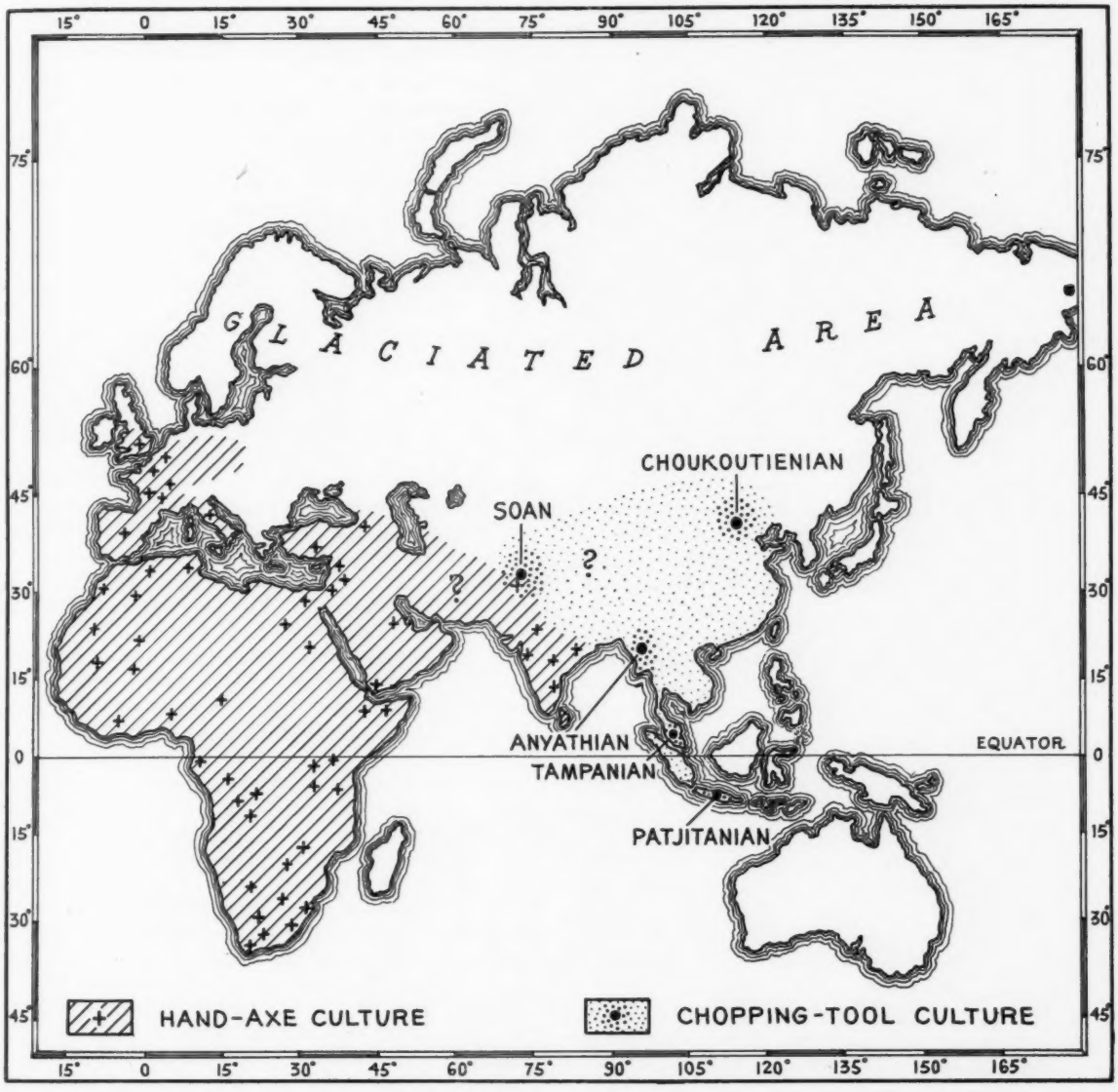
5. Although direct proof is still lacking, it appears probable that the Patjitanian of Java is the culture of *Pithecanthropus erectus* or his descendants. Such a view is strengthened by the completely convincing evidence from Choukoutien in China, where *Sinanthropus* (or *Pithecanthropus*) *pekinensis* was discovered in a fissure deposit together with choppers, chopping-tools, and a varied assortment of flake implements. Thus, it may well be that one of the most vital reasons why the cultures considered here are different from the classical developments found elsewhere possibly lies in the fact that we are also dealing with men belonging to a different branch of the human stock from that found outside the Far East.
6. In Burma and Java the Lower Palaeolithic cultures of "Eastern" affinities appear shortly after the introduction of a new "Eastern" faunal assemblage—Dr. von Koenigswald's *Sino-Malayan* fauna—at the beginning of the Middle Pleistocene. This fauna is present at many localities in the karst regions of Southern China, the Northern Shan States of Burma and Indo-China, as well as Java. It seems to link the *Sinanthropus* deposits with the Trinil horizon by a chain of *Stegodon*—Orang—Malayan Bear—*Aeluropus*-bearing fissures. As yet, however, scientific investigations of the latter are still in their infancy.

In cannot be too strongly emphasized that it is the *absence* of certain characteristic types of implements, as much as it is the *presence* of others, that identifies the Lower Palaeolithic chopper—chopping-tool complex of Southeastern Asia, Northern India, and China. Typical of other areas of the Old World are true hand-axes (*coup-de-poings* or *bifaces*) and flake implements made by the Levallois technique. It is only in Western Europe, on the extreme northwestern periphery of their distribution, that hand-axes of the great Abbevilleo-Acheulian complex and the Levallois flake indus-

[1] It seems likely that the affinities of the recently discovered Tampanian culture of Malaya, summarized on pp. 403–404, are with the Patjitanian, and that, although in each case a few hand-axes of "Eastern" type are present, there is no question that both cultures are overwhelmingly in the chopper—chopping-tool tradition.

[2] Compare van Riet Lowe, 1945.

[3] See Movius, 1943: 374–378.



MAP 4. The distribution of Lower Palaeolithic hand-axe and chopping-tool cultures in the Old World during late Middle Pleistocene times.

tries can be segregated. Elsewhere, these two appear to be mutually related;[4] indeed, as stated above, the distribution of those industries which are in the Levallois tradition very closely follows that of the great hand-axe complexes of the developed Acheulian type.

[4] This apparently holds throughout Africa (van Riet Lowe, 1944: 170; 1945) and in Peninsular India, as far as can be determined at present. In the Middle East, a centrally located region, Levallois flakes in association with hand-axes are in fairly strong evidence in the Upper Acheulian (e.g., Tabun: Levels E and F) of Mount Carmel in Palestine. (See Garrod, with Bate, 1937: 78–89.) In summarizing the techniques employed by Early Man during Lower Palaeolithic times to manufacture core as opposed to flake implements in the Belgian Congo, Dr. van Riet Lowe (1944: 170) has recently observed that "there is no vertical division between the essentially flake and core techniques in the Congo as there apparently is in Western Europe. The situation is precisely the same throughout Africa from the basin of the Nile to the Cape of Good Hope." (See also van Riet Lowe, 1937: 121–122.) In this connection, it is of interest to note that, on the basis of the evidence from Northern and Southern Rhodesia, both J. Desmond Clark (1939: 6 and 16) and Neville Jones (1938: 28; 1940: 9) have arrived at substantially this same conclusion.

As shown on the map (map 4), this distribution extends as a huge triangle, embracing the whole of Africa, the Middle East, and Peninsular India, as well as the southern, central, and western portions of Europe. But in certain parts of the vast area, especially in East, Central, and South Africa and Peninsular India, choppers and chopping-tools, for the most part made on pebbles, occur. In fact, pebble implements of one or the other of these two basic types seem to be characteristic of the very earliest true Lower Palaeolithic horizons (Kafuan, Oldowan, or Pre-Stellenbosch) in the following areas: the Vaal Valley,[5] the Transvaal,[6] Northern Rhodesia,[7] Southern Rhodesia,[8] the Capetown Region,[9] Moçambique (Portuguese East Africa),[10] Angola (Portuguese West Africa),[11] and the Belgian Congo,[12] as well as Tanganyika, Uganda, and Kenya.[13] In Asia, exclusive of the regions under discussion, choppers and chopping-tools occur in the Lower Palaeolithic of the Narbada Valley of Central India,[14] and elsewhere in the peninsula, according to information received from Dr. E. C. Worman. Rather than attempt to link these to a single stem, as Dr. Paterson has advocated,[15] it appears much more likely that the evidence suggests an extremely wide distribution of primitive tools of the chopper variety at an early stage in the Pleistocene of the Old World. Thus they may well be indicative of a sort of basic cultural substratum. But with the gradual development of pointed, bifacial core tools of true hand-axe type all over Africa, Central and Southern India, the Middle East, and Europe, choppers became of secondary importance, except in certain isolated instances, e.g., the Kafuan. In Southeastern Asia and China, on the other hand, this ancient tradition persisted and continued to develop uninfluenced by the contemporary technological innovations found elsewhere. In Northwestern India, however, where the same complex occurs, it was modified as a result of influences from (or ? fusion with) classic Lower Palaeolithic sources. This is demonstrated by the occurrence of a pronounced Levalloisian aspect, particularly apparent in the Late Soan. In Java and Malaya, there is as yet no positive evidence of foreign introductions. Here a development comparable with that which culminated in the Acheulian of other regions appears to have been under way, at least as early as the beginning of Upper Pleistocene times.

That an analogous but totally unrelated development took place in Africa, apparently at an earlier period, is indicated by the typology of the archaeological material from the alluvial deposits exposed in the Oldoway Gorge, Tanganyika. Dr. Leakey states, with regard to the implements from the earliest horizon at this locality (early Middle Pleistocene on the basis of Leakey's chronology), "the pebble-tools of the Oldowan culture towards the top of Bed I, show a tendency to be trimmed in such a way as to leave a cutting edge on both sides, and in the lowest part of Bed II this tendency becomes a dominant character, and the trimming of two sides of a pebble leads to the making of very crude and simple hand-axes, which I regard as marking the first true stage of the Chellean culture."[16] Such a development also seems to have taken place in South Africa, where there appears to be little doubt that the various pebble cultures are closely related to those of East Africa. On the basis of the evidence of the material from the earliest implementiferous gravels in the Vaal Valley, Dr. van Riet Lowe states that "when one considers the congeries of the next horizon (Stellenbosch I), it is even possible that this pebble culture of the Vaal may be accepted as the South African counterpart of the first true stage of the old Chellean culture."[17] This evidence supports the view expressed on page 361, regarding the probability that the Patjitanian hand-axes should be considered as a case of independent development. For, if an implement of this type could have been evolved out of pebble choppers and chopping-tools in Africa during Lower Palaeolithic times, certainly a similar net result could have also been achieved in Southern Java, a region where the chopper—chopping-tool complex of Southern and Eastern Asia was particularly highly developed.

Although flake implements are present in all the chopper—chopping-tool cultures that comprise the new "Eastern" complex of Lower Palaeolithic development, this complex is none the less fundamentally in a tradition or basic continuum of core tools, in many instances made on pebbles. In other words, as Dr. Braidwood has recently remarked, the present data suggest "that the persistent *habits* used by the prehistoric men of this area in fashioning their tools differed from those habits or traditions current in the West."[18] From a typological point of view, the tools from Southern and Eastern Asia are in fact *single-edged* core tools (with

[5] van Riet Lowe, 1937: 75–76; Breuil, 1943*a*; 1943*b*; Goodwin, 1946*b*: 84–85.

[6] Smuts, 1938; 1945*a*; Wayland, 1929.

[7] Clark, J. D., 1939: 3 and 7–8.

[8] Jones, Neville, 1940: 1–3. Although pebble tools occur in Southern Rhodesia (Mondoro Industry), they have not as yet been found in a definite horizon demonstrably older than one containing hand-axes.

[9] MacFarlane, 1935; Breuil, 1945: 363–365 and 371–372.

[10] Smuts, 1945*b*: 71–72; also van Riet Lowe and Breuil, 1944.

[11] Janmart, 1946: 75–80.

[12] Breuil, 1944: 143 and 155; van Riet Lowe, 1944: 169 and 172.

[13] Leakey, 1934: 144–146; 1936: 39–41; Wayland, 1934; O'Brien, 1939: 69–94.

[14] de Terra and Paterson, 1939: 321–326.

[15] Paterson, 1941: 379; 1945: 16–17.

[16] Leakey, 1936: 41.

[17] van Riet Lowe, 1937: 76. Following the new terminology adopted since this paper was written, all terms hitherto used to describe the major divisions of the great hand-axe culture of Africa have been discontinued. On this basis the various developments of this culture should now be called Chelles-Acheul; the term Stellenbosch is accordingly obsolete. (See footnote 20 on p. 358.)

[18] Braidwood, 1947: 37.

the exception of a few double-ended forms and the pointed proto-hand-axes and hand-axes of Java and Malaya) as opposed to the *double-edged* core tools, which are bifacially flaked and generally referred to as *bifaces*.[19] These two more or less contemporary core tool traditions, both of which are confined in a broad sense to distinct geographical areas, in so far as the main development of each is concerned, can be defined as follows: (*a*) Western—characterized by double-edged, bifacial cutting tools, or *hand-axes;* and (*b*) Eastern—characterized by single-edged cutting implements, or *choppers* and *chopping-tools*.

Although there still remain vast areas to explore within those regions of Southern and Eastern Asia where the great chopper—chopping-tool complex is distributed, it is perhaps not premature to point out that several culture areas, or provinces, within the main complex can be already discerned. These have been outlined below:

Western Area—At present represented only by the Soan culture of Northwestern India. Chopper and chopping-tool types made on pebbles in association with plain flakes predominate in the early phases. The Soan was apparently in contact with a culture belonging to the great hand-axe complex; the Late Soan reveals a marked "Levalloisian" influence.

Northern Area—Found in Northern China, where it is represented by the Choukoutienian culture. Chopper and chopping-tool types made on pebbles are common; also choppers made on large flakes. A large series of unspecialized quartz tools made principally on small flakes and flake fragments is a special feature, and one apparently developed in response to the type of fracture possessed by the quartz, rather than by following a definite technique of knapping.

Central Area—This is known mainly from the Anyathian of Burma, but it has recently been discovered in Thailand. Furthermore, on the basis of the indications thus far brought to light, it is possible that further work will reveal that Southern China should also be included in this area. As regards the Anyathian of the Irrawaddy Valley, the tools are entirely composed of choppers, chopping-tools, hand-adzes, and a few plain flakes. A large number of the Anyathian implements are made of fossil wood.

Southern Area—In addition to all the various types of implements found in the areas to the north, especially those of the Central Area, hand-axes and a large series of proto-hand-axes are present in the Patjitanian of Java, thus far the best known culture in the Southern Area. The evidence secured to date indicates that tools of the hand-axe type were developed independently in Southeastern Asia (see p. 361), a view that is reinforced by the fact that flakes made by the so-called "Levallois" technique (invariably associated with the developed hand-axe cultures in other parts of the Old World) are completely absent in Java. The present evidence strongly suggests that the Tampanian culture of Malaya belongs in the Southern Group, which may well be expanded to include Sumatra (see note 24, p. 364) and possibly Borneo, if and when these areas can be more thoroughly explored.

Perhaps the most important single conclusion to be drawn from the implications of the new archaeological material brought to light during the last fifteen years in Southern and Eastern Asia is that this area cannot be considered in any sense "progressive" from a cultural point of view. Indeed, throughout the early portion of the Old Stone Age the tools consist for the most part of relatively monotonous and unimaginative assemblages of choppers, chopping-tools, and hand-adzes. As Dr. Teilhard de Chardin has observed, with reference to the enormous span of time represented by the Middle Pleistocene, Eastern Asia "gives the impression of having acted (just as historical China, and in sharp contrast with the Mediterranean world) as an isolated and self-sufficient area, closed to any major human migratory wave. Cultural and racial connections during this period seem to have been *chiefly with the South.*"[20] In other words, the archaeological, or palaeo-ethnological,[21] material very definitely indicates that as early as Lower Palaeolithic times Southern and Eastern Asia as a whole was a region of cultural retardation. Therefore, it seems very unlikely that this vast area could ever have played a vital and dynamic role in early human evolution, although very primitive forms of Early Man apparently persisted there long after types at a comparable stage of physical evolution had become extinct elsewhere.

[19] In order to avoid using a term with a functional connotation—i.e., choppers and chopping-tools—as advocated by Braidwood (1946: 134; 1947: 37), choppers could be called *unifaces* or *monofaces* on this basis, both of which terms imply form rather than use. However, chopping-tools, which in all instances are worked on *two* sides of the cutting edge, cannot be fitted into this scheme. Although the matter is of relatively little importance, the writer would welcome any suggestions bearing on this question of terminology. In this connection, it should be borne in mind that, regardless of what terms are employed, it is only possible to achieve a very low order of objectivity in describing prehistoric cultural material, since any given verbal label or set of sounds inevitably connotes some sort of association, which is bound to differ in degree depending on the individual.

[20] Teilhard, 1941: 86 and 88.

[21] Compare Childe, 1946: 243–244 and 251; Garrod, 1946: 16; Radcliffe-Brown, 1944: 257; Movius, 1944: 8 and 106.

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